ANNUAL RESEARCH REVIEW 2020

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES
SRI LANKA

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The National Institute of Fundamental Studies

&

The 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 WORLD RENOWNED CENTER OF EXCELLENCE FOR RESEARCH IN FUNDAMENTAL STUDIES

OUR MISSION

INITIATE, PROMOTE AND ENGAGE IN ADVANCED RESEARCH IN FUNDAMENTAL STUDIES FOR THE ENHANCEMENT OF SCIENTIFIC KNOWLEDGE AND DEVELOPMENT OF HUMAN RESOURCES CONTRIBUTING TO NATIONAL DEVELOPMENT.

Message from the Chairman

I am delighted to provide this message to the Annual Research Review in my capacity as the Chairman of the National Institute of Fundamental Studies. The Annual Research Review is of critical importance as it leads us to reflect on what we have been doing for the past year, identify and consolidate our strengths, minimise identity, consolidate our strengths, and minimise our weaknesses or limitations. It also provides us with a good platform to revise our strategies and direction. A strategy is capturing opportunity; it is not static but a dynamic process.

In the light of an unprecedented global pandemic, COVID 19, there will be continued challenges for quite some time despite the introduction of vaccines and the relative success story of Sri Lanka in pandemic control. We must, therefore review not only our research but also the context in which the research is carried out.

Knowledge is power. As there is a global divide in research, there is a global divide in power, which, in turn, has an impact on who dictates the agenda of generating new knowledge. There is an intimate relationship between knowledge, power and injustice.

The discipline that deals with such power and injustice is ethics. Ethics is about relationships. As relationships involve consideration of power, there is a close link between ethics and power too. The field of ethics, also known as moral philosophy, is a way of preserving, regulating and advocating the behaviours broadly classified as right or wrong.

The third aspect of the Research Review, in addition to the reflection on science, and the context of the research, is that it should focus on the conduct of the scientist. Education and awareness creation, strict and specific rules governing the issues of conflict of interests and disclosure, as well as creating a culture of accountability among scientists who use public resources, is essential. The integrity of a scientist is as important as the robustness of scientific methods.

"Quis custodiet ipsos custodes?" wrote Juvenal, the 1st century AD Roman poet. This translates to "who will guard the guardians themselves," a troubling question about power and the potential for its abuse, which remains valid even today in many contexts. Governance has gate-keeping, intended to address power equation at various levels of the knowledge generation process.

Under these circumstances, we need a culture shift to move towards research for people's benefit. We are free education products, use public knowledge, and use public money; we, the scientists, should therefore be held accountable to people and society.

I would like to thank the organising committee for asking me to share my thoughts. I would like to propose new dimensions for Annual Reviews in the years to come to review science and the process.

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

Professor 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

The National Institute of Fundamental Studies (NIFS, formerly Institute of Fundamental Studies, Sri Lanka) established by an Act of Parliament (Act No. 55 and amendments) in 1981 was the brainchild of H E J. R. Jayawardhana, who firmly believed that national development programs should always harmonize with their respective fundamental research components. NIFS is mandated to conduct fundamental research to improve knowledge and find solutions to burning national problems. Despite the challenges we have faced in the past year, we have made tremendous progress in our research outcomes, institutional development and knowledge dissemination while engaging in important national programs.

The Annual Review is the NIFS' yearly opportunity to consolidate research and dissemination efforts of the previous year, set itself new goals and provide a platform to assess, review and establish new goals and targets for the forthcoming year.

At the NIFS there are currently 19 research programs, 18 scientists, 78 research students, and four national centers. The NIFS Adjunct Professorships drew 18 excellent scientists from around the world at no expense to the Institute. NIFS scientists have 51 scientific partnerships with national and foreign research institutes and were able to attract funding for 7 new and 34 ongoing projects from a number of national and international funding bodies. NIFS scientists are acclaimed worldwide, especially in research. Over the last 12 months our scientists published 25 research articles in Q1 journals, fourteen in Q2 journals and over forty other publications in refereed journals. They also managed to publish seven books / book chapters and ten articles in newspapers and magazines to take our research to the general public. During this period, six PhD, five MPhil, two Masters and fourteen BSc research projects were completed.

NIFS is mandated to train postgraduate students. Currently, a large number of postgraduate students pass through our training program and this helps to minimize the brain drain in the country. Our science outreach program to schools has passed 669,012 students, with 6000 of them having visited NIFS and gained first-hand experience working in our high end laboratory facilities. NIFS takes its role to produce major outcomes for society from the fundamental studies carried very seriously. To this effect, over two decades of fundamental research in molecular microbial biotechnology, has led to scientific discoveries that have transformed into application science, producing biofilm fertilizers as an alternative to chemical fertilizers. Our scientists have also successfully conducted research in the production of high-end technology, in particular battery technology, which has a great potential to be taken to the international market. Currently, our researchers are also focusing on addressing burning national issues like, COVID 19, human-animal conflicts, chronic kidney disease, food and nutrient security, water quality, especially generating fundamental knowledge that is required to address these issues.

In consonance with the Vistas of Prosperity and UNSD goals, NIFS is committed to sharing research skills and knowledge with the government of Sri Lanka in order to further improve the economy. The instrument facility at NIFS will become a great research asset for all the institutes around the country for much needed sample analysis. The Institute's promotion of public awareness and social outreach of our research through a dedicated science dissemination program will ensure future generations of students becoming interested in STEM education and pursuing research as a career. With the research faculty of the Institute to be doubled in the near future along with improved laboratory and residential facilities, it is my heartfelt hope that the NIFS will emerge as a model institute not only nationally but also globally. NIFS is on a fascinating path of growth and development. I wish all the scientists and staff the very best in the years to come

Professor Saman Seneweera
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Director and Senior Research Professor
National Institute of Fundamental Studies

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SECTION I – RESEARCH UNITS

Energy & Advanced Materials

Energy and Advanced Materials project unit at the National Institute of Fundamental Studies covers several ambitious projects dealing with technologically important novel materials and devices. These are being investigated under four broad themes: Condensed Matter Physics and Solid State Chemistry project mainly deals with synthesis and characterization of novel polymeric electrolytes for dye sensitized solar cells, rechargeable batteries and electrochromic display devices. Nanotechnology and Advanced Materials project covers target oriented fundamental and advanced investigations leading to develop Sri Lankan minerals and related materials for nano-technological and advanced materials based applications.

Energy and Advanced Materials Chemistry project focuses on chemistry and physics of novel materials for the conversion of solar energy into chemical and electrical energies. Material Processing and Device Fabrication project involves experimentation and basic studies in Materials Processing and Device Fabrication with emphasis on graphite, graphite based devices and carbon supercapacitors.

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

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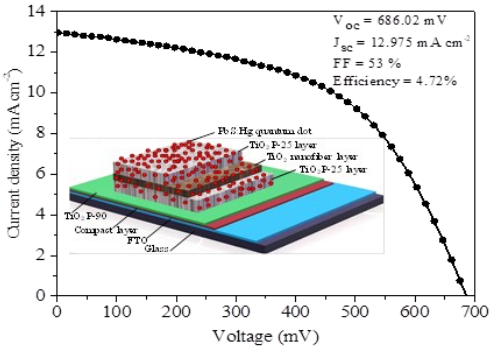
Condensed Matter Physics & Solid State Chemistry

Condensed Matter Physics and Solid State Chemistry programme at NIFS focuses on uncovering novel phenomena and materials which are scientifically intriguing and technologically important. Fabrication of solid state and quasi-solid state devices such as dye sensitized, quantum dot sensitized and plasmonic solar cells, electrochromic displays, novel polymer electrolytes for solar cells and rechargeable magnesium ion batteries, and polymer nanofibre water filters for bacteria and heavy metal removal are some of the projects undertaken during 2020 under the Condensed Matter Physics & Solid State Chemistry programme. The main emphasis was on efficiency enhancement of dye sensitized solar cells (DSSCs) by introducing novel modifications to the photoanode, the electrolyte and the counter electrode.

During 2020, several projects on dye sensitized and quantum dot sensitized solar cells have been completed successfully by our group. These are (a) A novel, highly efficient, PbS: Hg quantum dot–sensitized, plasmonic solar cells with TiO_2 triple-layer photoanode, (b) Effect of PbS quantum dot-doped polysulfide nanofiber gel polymer electrolyte on efficiency enhancement in CdS quantum dot-sensitized TiO_2 solar cells, (c) Efficiency enhancement in PbS/CdS quantum dot-sensitized solar cells by plasmonic Ag nanoparticles, (d) Effect of electrolyte conductivity, co-additives and mixed cation iodide salts on efficiency enhancement in dye sensitized solar cells and (e) Solid-state solar cells co-sensitized with PbS/CdS quantum dots and N719 dye and based on solid polymer electrolyte with binary cations and nanofillers.

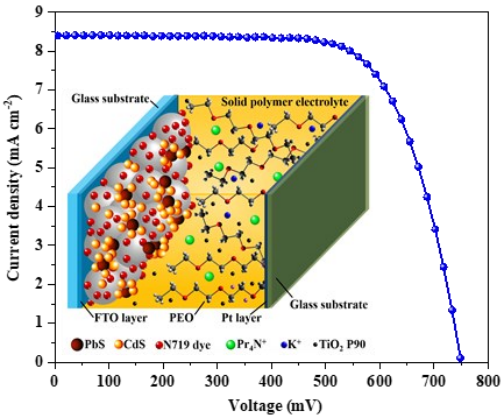
A novel, highly efficient, PbS: Hg quantum dot–sensitized, plasmonic solar cells with TiO_2 triple-layer photoanode

Hg-doped, PbS quantum dot-sensitized solar cells (QDSSCs) were fabricated using successive ionic layer adsorption and reaction (SILAR) method with TiO_2 single layer, double layer and triple layer photoanode nanostructures. The triple layer TiO_2 photoanode was fabricated by using a TiO_2 nanofibre (NF) layer sandwiched between two TiO_2 nanoparticle (NP) layers in order to enhance light harvesting through effective light scattering process. The Q-dot sensitized, TiO_2 triple layer nanostructure based QDSSC showed a high energy conversion efficiency of 4.72 % under the simulated light of 100 mW cm^{-2} with AM 1.5 filter. The enhanced solar cell efficiency has been attributed to improved light harvesting by multiple light scattering in the tri-layer TiO_2 photoanode structure.



Solid-state solar cells co-sensitized with PbS/CdS quantum dots and N719 dye and based on solid polymer electrolyte with binary cations and nanofillers

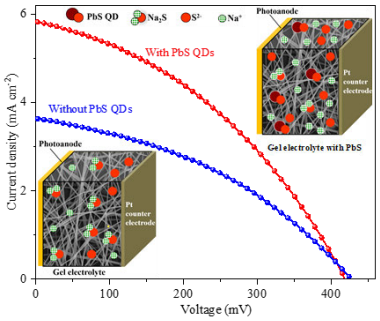
Co-sensitized solar cells have gained more attention due to the ability of energy conversion process by absorbing photons from wide range of the solar spectrum including visible and near-infrared region. TiO_2 electrodes were co-sensitized with PbS/CdS core-shell quantum dots and N719 dye. PbS/CdS/N719 dye-sensitized solar cells were fabricated with poly(ethylene oxide) based solid polymer electrolyte consisting iodide/triiodide redox couple. The iodide ion conductivity of the electrolyte was enhanced by incorporating a binary iodide salt mixture of different size cations, tetrapropylammonium iodide and potassium iodide. The performance of the solar cell was further enhanced by the incorporating TiO_2 P90 nanofiller in the electrolyte. The best solid-state solar cell showed a significantly higher efficiency of 4.41% with a short-circuit current density of 8.41 mA cm^{-2}, open-circuit voltage of 748.3 mV and a high fill factor of 70.16% under the simulated light of 100 mW cm^{-2} with AM 1.5 filter. This is the first report describing the efficiency enhancement in a solid-state dye sensitized solar cell based on a solid polymer electrolyte incorporating a binary cation iodide salt and TiO_2 nanofiller and a photoanode co-sensitized with PbS/CdS quantum dots and N719 dye demonstrating the cumulative effect by the mixed cation effect and co-sensitization.



Effect of PbS quantum dot-doped polysulfide nanofiber gel polymer electrolyteon efficiency enhancement in CdS quantum dot-sensitized TiO_2 solar cells

Quantum dot-sensitized solar cells (QDSSCs) are among the most promising low cost third generation solar cells. Semiconductor quantum dots have unique properties such as high molar extinction coefficients, tunable energy gap by the quantum confinement effect and the ability of multiple exciton generation. In this study, stable CdS QDSSCs were fabricated by using polysulfide liquid electrolytes and also by using cellulose acetate nanofiber-based gel electrolytes. Incorporation of PbS Q dots to the liquid or gel electrolyte showed a significant enhancement in solar cell efficiency. Under the simulated light of 100 mW cm^{-1} the efficiency of the polysulfide liquid electrolyte based CdS QD solar cells increased from 1.19% to 1.51% and the efficiency of the nanofibre gel electrolyte based CdS QD solar cells increased from 0.94 % to 1.46% due to the incorporation of 5% (wt/wt) PbS Q dots into the respective electrolytes. to

The efficiency increase has been attributed the increase in short circuit photocurrent density due to increased sulfide ion (S^{2-}) conductivity evidently caused by indirect ionic dissociation facilitated by PbS QDs.



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

In this work, 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) solvent based electrolyte. The reference DSSC made with electrolyte using only TPAI as the iodide salt exhibited an efficiency of 5.26%. However, using two binary iodide salts KI and Pr_4NI and incorporating 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 complexation with TBP, the efficiency of DSSCs reached an impressive 8.01%. The overall efficiency enhancement has been explained by the mixed cation effect and the synergistic effect of the two co-additives TBP and GuSCN

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Key publications

1. Polyaniline (PANI) mediated cation trapping effect on ionic conductivity enhancement in poly (ethylene oxide) based solid polymer electrolytes with application in solid state dye sensitized solar cells
   MAKL Dissanayake, JMKW Kumari, **GKR Senadeera,** T Jaseetharan, B-E Mellander, I Albinsson, M Furlani;
   Reactive and Functional Polymers (2020), Volume155, Pages 104683

2. Effect of PbS quantum dot-doped polysulfide nanofiber gel polymer electrolyte on efficiency enhancement in CdS quantum dot-sensitized TiO2 solar cells
   MAKL Dissanayake, T Liyanage, T Jaseetharan, **GKR Senadeera,** BS Dassanayake,
   Electrochimica Acta, (2020) Volume 347, Pages 13631

3. Efficiency enhancement in dye-sensitized solar cells using hierarchical TiO_2 submicron size spheres as a light scattering layer
   MAKL Dissanayake, S Senthuran, **GKR Senadeera**
   Journal of Solid State Electrochemistry (2020) Volume 24(10)2261-2269

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The influence of citric acid linker molecule on photovoltaic performance of CdS quantum dots sensitized TiO_2 solar cells

Quantum dot sensitized solar cells (QDSSCs), which belong to the third-generation photovoltaic devices, have drawn enormous attention in recent years because of the possibility of boosting their efficiencies beyond the theoretical limit proposed by Shockley–Quiesser. Even though significant research studies have been performed on these QDSSCs, the power conversion efficiencies of these QDSSCs without any modifications are generally very low. In order to achieve high efficiencies in QDSSCs the QDs have to be properly adhered to the TiO_2 nanocrystallinesemiconducting photoanode surface while having efficient pathways for photo-generated electrons or holes to be extracted from QDs before they recombine. In this context, linker or ligand assisted assembly method where, some molecules are used to tethering the already synthesized QDs to the surfaces of the substrates like TiO_2 have been introduced. However, little work has been reported on quantum dot sensitized solar cells fabricated with CdS tethered to TiO_2 via linkers. Therefore, by considering all these factors, for the first time, we have demonstrated the possibility of using citric acid successfully as a linker molecule and a capping agent in the fabrication of CdS sensitized QDSSCs. Tethering of citric acid molecules with both TiO_2 and CdS quantum dots (QDs) was confirmed by Fourier Transform Infrared Spectroscopy technique. High-resolution transmission electron microscopic studies reveled that QDs with average size of ~ 4.5 nm were tethered with TiO_2nano particles of diameter ~ 40 nm. Presence of Cd, S, C, Ti, and O elements in the composite photoanode and their uniform distribution throughout the photoanode were confirmed by the Energy Dispersive X-Ray Spectroscopy measurements. QDSSCs fabricated with pristine TiO_2pohotoanode exhibited a short circuit current density (J_{SC}) of 5.80 mA cm^{-2} and an overall power conversion efficiency (h) of 1.10 % , whereas solar cells made with citric acid treated, photoanode exhibited a J_{SC} of 8.20 mA cm-2 with 1.5% efficiency under 100 mW cm^{-2} (AM 1.5) light illumination. This is an impressive 60% increase in the $J_{SC}$and ~ 36 % enhancement in the overall power conversion efficiency. Interfacial resistance of QDSSCs estimated by using electrochemical impedance spectroscopy revealed that, citric acid treatment enhanced both the electron injection to the conduction band of the TiO_2 from the CdS as well as the overall charge transfer of the device while decreasing the recombination of the photo generated electrons with their holes in the electrolyte.

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Prof. Jayasundera Bandara

Jayasundera Bandara,is a Senior Research Professor in NIFS, since 2015 to date. His research is focused in novel materials and nanostructures for application in dye/q-dot sensitized solar cells and solar fuels production. He has 89 research publications in SCI journals (5971 citations, h-index 39) and is in the 2020 Stanford University List of World`s Top 2 per cent researchers. He was honored 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, Geroge 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 (2000-2016);.CAS President's international fellowship initiative(pifi) award (2017-2018), Chinese Academy of science, China.

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Energy & Advanced Material Chemistry

The Energy & Advanced Material Chemistry project conduct research on renewable energy and specifically our research is mainly focused on 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 carry 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 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

As energy is the most important commodity in the modern world, the conversion and storage of solar energy by means of artificial photosynthesis is a promising technology in producing chemical fuels such as hydrogen via water splitting. In artificial photosynthesis, solar energy can be converted to chemical fuels with the assistance of photocatalytic processes or by directly combining photovoltaic and electrolysis systems.

Photoelectrolysis in which the photoelectrode collects solar energy and electrolyzes the water, i.e. photoelectrochemical cells (PEC) is of great interest in converting and storing of renewable energy. Research is now concentrated on the development of low-cost, highly stable water splitting using PEC cells. Copper zinc tin sulfide (CZTS) is one of such a promising p-type semiconductor materials suitable for various photovoltaic applications owing to its optimum bandgap of 1–1.5 eV with a high absorption coefficient of 10^4 cm^{-1} and also consisting of earth-abundant, low cost and low toxic elements. The important fact about the CSTZ based solar cells is that the theoretical conversion efficiency of CZTS solar cells is expected to be over 30%. The major barrier and the inherent problem in the fabrication of CZTS film is the formation of high density of intrinsic defects and binary compounds within the film during the deposition of CZTS films that would result in reduced carrier diffusion length and carrier lifetime. To address the main issue, we investigated several methods to mitigate the formation of intrinsic structural defects and the formation of binary compounds in CZTS nanostructures. As quality of CZTS films highly depended on the effect of sulfurization process, the influence of precursor sulfur concentration on structural, optical, morphology and electrical properties of CZTS thin films prepared by thermal evaporation method were reported in this investigation. In this study, CSTZ films were fabricated by a two steps process. First CZTS powder was prepared by changing the sulfur ratio of precursor solution followed by deposition of CZTS powder on fluorine-doped tin oxide (FTO) glass substrate by thermal evaporation.
The electrode performance of the CZTS thin-film photocathode was investigated in a three-electrode photoelectrochemical cell.

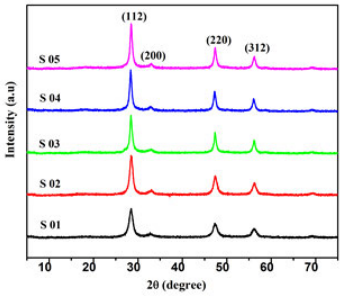

Figure 1: XRD patterns of CZTS films of S-01, S-02, S-03, S -04 and S05 on FTO substrate.

The XRD patterns of different CZTS films fabricated with the initial sulfur concentration are shown in Figure 1.The XRD and Raman scattering results indicate that the CZTS thin film fabricated with higher precursor sulfur content consists of the major phase of kesterite CZTS and minor phases of ZnS and CTS and no other secondary phases such as CuS and SnS.

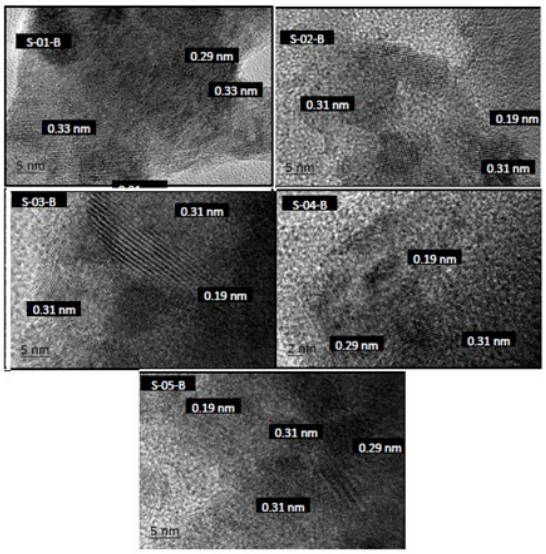

Figure 2 (a) HRTEM images of CZTS samples S-01, S-02, S-03, S-04 and S05 synthesized by varying the thiourea concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 M respectively.

In high resolution TEM images shown in Fig. 2 for CZTS nanoparticles synthesized at various sulfur concentrations, the major lattice spacing was found to be 3.1°A which corresponds to the lattice spacing of (112) planes for kesterite CZTS NCs and also in complete agreement with XRD measurements.[40]

Additionally, lattice spacing of 1.9°A that corresponds to (220) plan of CZTS structure also could be clearly observed in all the images. Significantly, observation of clear lattice fringes throughout the whole CZTS nanoparticles synthesized at higher sulfur concentrations indicate the highly crystalline quality of the nanoparticles formed at higher sulfur concentrations than the lower sulfur concentrations.

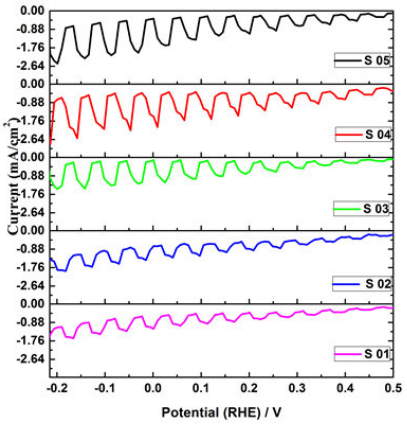

Figure 3: Photoelectrochemical Performance of CZTS photocathode fabricated with different S ratios in 1M Na_2SO_3 solution (pH 7) under chopped solar-simulated AM 1.5G light irradiation. (S-01, S-02, S-03, S-04 and S05 represent the thiourea concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 M respectively)

As shown in Fig. 3, with the increase of the initial sulfur precursor concentration enhanced photocurrents were observed and the maximum photocurrent density of ~ 3.0 mA/cm^2 was observed when the S content was equal to 0.8 M (sample S04) and almost leveled off above the S content of 0.8M (sample S05). Calculation of the half-cell solar-to-hydrogen efficiency (HC-STH) using the current-potential curves reveals an HC-STH of 0.15, 0.20, 0.25, 0.32 and 0.31% at 0.22 V RHE for the CZTS/FTO electrodes of S01, S02, S03, S04 and S05 respectively.

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Key publication:

1. K.M.S.D.B. Kulathunga, C-F. Yan, **J. Bandara,** Photocataytic removal of airborne indoor pollutants by IR illuminated silver coated TiO_2 catalyst: Advantage of One-dimensional TiO_2 nanostructures in IR active photocatalysis, *Colloids and Surfaces A: Physicochemical and Engineering Aspects* 590 (2020)124509

2. Hong-Yi Tan, Liang Zhan, Chang-Feng Yan, Lahiru K Abeykoon, Nuwan L De Silva and **Jayasundera, Bandara**,Enhancement of the conversion of mechanical energy into chemical energy by using piezoelectric $KNbO_{3-x}$ with oxygen vacancies as a novel piezocatalyst, ***Nano Express,*** *1* (2020) 030036

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Material Processing & Device Fabrication

The Research Project conducts investigations related to conversion of Sri Lankan graphite into highly value-added super expanded graphite and graphene products for utilization as counter electrodes in solar cells such as dye-sensitized solar cells and perovskites solar cells to replace expensive platinum counter electrode. This work covers following basic and applied aspects: Firstly to add value to readily available Sri Lankan Vein Graphite and to present exporting raw materials in their raw form without value-addition. The work involve finding ways for purification to enhance electrical conductivity. Secondly, to use such value-added graphite and graphene products as counter electrodes in solar cells to bring down the cost of solar cell production. Another area of the project is to utilize coconut shells and to convert them to highly porous and highly conducting activated charcoal for utilization as super capacitor electrodes and also in dye sensitized and perovskite solar cells. The current problem of perovskite solar cells is the instability. Investigations have also been carried out to find ways of resolving this problem.

Fabrication of graphite/graphene based composite counter electrode for dye-sensitized solar cell.

Dye-sensitized Solar Cells (DSCs) are gaining much attention as an alternative to silicon-based solar cells due to their low cost, easy fabrication and reasonable efficiency. Platinum (Pt) is still widely used as a counter electrode material in DSC devices. In this research, highly expensive Pt counter electrode has been replaced by low cost floated graphite/ graphene composite counter electrode. The composite counter electrode was developed on conducting glass substrate by screen printing method. Graphene and floated graphite were prepared using Sri Lankan natural vein graphite where modified Hummer's method used for the preparation of graphene. Power conversion efficiency was optimized by varying graphene/graphite composition and thickness of the composite film. A maximum power conversion efficiency of 5.88%, with *Jsc* of 12.05 mA cm^{-2}, *Voc* of 0.740 V, *FF* of 0.66, showed the DSC fabricated using composite counter electrode with 1:1 graphite/graphene ratio, which is comparable to power conversion efficiency of 8.24% with *Jsc* of 14.67 mA cm^{-2}, *Voc* of 0.759 V, and *FF* of 0.74 fabricated using Pt counter electrode based solar cell. The J-V characteristics of the DSCs with Pt and 1:1 composite counter electrodes are shown in Figure1.

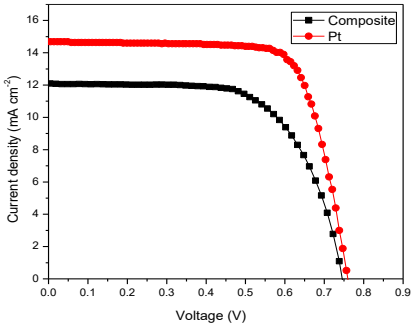

Figure 1: The J-V Plots for DSCs fabricated with Pt and 1:1 composite counter electrodes

Pt counter electrode based DSC showed the higher efficiency than the composite counter electrode based DSC due to the low *Jsc, Voc* and *FF* values. This research implies the ability to substitute expensive platinum counter electrode by inexpensive graphite/graphene composite counter electrode that prepared using Sri Lankan vein graphite for DSCs.

Powder pressed Cuprous Iodide (CuI) as a Hole Transporting Material for perovskite solar cells.

Perovskite solar cell (PSC) has intensively been focused on improving the efficiencies and stability for the past few years. Various Hole Transporting Materials (HTMs) have been reported in optimizing the performance of the PSC and the best efficiencies have been reported using 2,2',7,7'-Tetrakis[N,N-di(4-methoxyphenyl)amino]-9,9'-spirobifluorene (Spiro-OMeTAD) as HTMs. However, spiro-OMeTAD has several challenges related to cost, stability and poor carrier mobility. As such, replacing this HTM by a low-cost alternative would result in bringing down the overall cost of the device. This work attempted to fabricate solvent free route to make low-cost CuI HTM by simply pressing CuI between perovskite layer and Pt coated FTO glass. CuI possesses several unique characteristics, such as high transparency, low-production cost, ease of deposition, high hole-mobility and good chemical stability. This solvent free pressed method of hole transport layer is hazard free and simple method capable for the large-scale production of PSCs. For comparison purpose, PSCs were fabricated by spin-coating spiro-OMeTAD between perovskite layer and thermally evaporated Au top-contact (figure2).

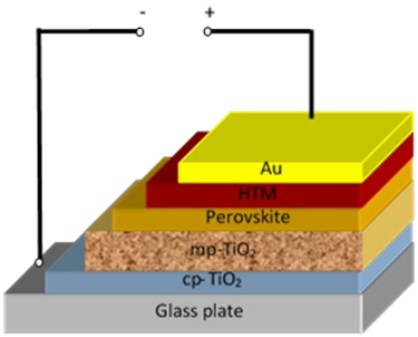

Figure 2. Schematic diagram of PSC.

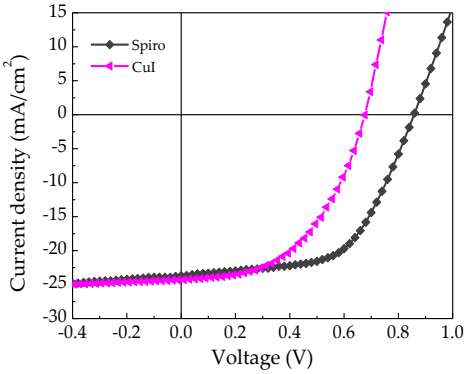

Figure 3. The J-V characteristic of the devices with Spiro-OMeTAD and CuI as the HTMs.

Table 1 summarizes the average photovoltaic properties of solar cells fabricated with Spiro-OMeTAD and CuI.

Table 1. Photovoltaic properties of solar cells fabricated with Spiro-OMeTAD and CuI.

HTMs	*Jsc* (mA/cm^2)	*Voc* (V)	*FF*	*PCE* (ŋ %)
Spiro-OMeT	23.7	0.85	0.59	11.9
CuI	24.2	0.67	0.50	8.1

The PV performance of the devices with Spiro-OMeTAD as the HTM outperformed the CuI devices. As discussed in the literature, the Spiro-OMeTAD is shown to be the best HTM for PSCs so far. However, the *Jsc* of the devices with CuI is marginally higher than the Spiro-OmeTAD devices. Average *Jsc* of the CuI devices was 24.2 mAcm^{-2} which is higher than that of Spiro-OMeTAD devices (23.7 mAcm^{-2}) which is consistent with higher hole-mobility found in CuI than Spiro OMeTAD.

The efficient charge extraction between the perovskite and CuI lead to an excellent hole injection from the perovskite films to CuI. However, the performance of the devices with CuI was limited with lower *Voc* (0.67 V) and *FF* (0.50) than that of the devices with spiro-OMeTAD (*Voc* = 0.85 V and *FF* = 0.59). The lower *FF* of the CuI devices can be correlated to the higher thickness and roughness of CuI film. The spiro-OMeTAD devices fabricated in our laboratory have efficiencies lower than that of reported in a close environment. In our work, all the device fabrication process and characterizations were done in an open atmosphere, this could be the reason for the lower performance of the devices.

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Nanotechnology and Advanced Materials

Nanotechnology and Advanced Materials are currently the most progressive fields that are playing a key role in improving the economic performance and the quality of life. These two fields have together significantly contributed to the 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 resources. Sri Lanka possess a variety of economically useful minerals that are still exported as cheap raw materials. Though they have the potential to play a major role in global nano-tech and other high-tech industrial applications, proper value addition to our minerals, by upgrading for such applications, is lacking.

From the inception in 2013, this Nanotechnology and Advanced Materials (NAM) research project of NIFS has been paying a serious consideration to the above mention factors inherent to our country, whenever in adapting or contributing to these versatile fields of Nanotechnology and Advanced Materials. It is addressed by emphasizing 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, such as energy storage, water purification, synthesis of nano-materials and highly upgraded raw materials for high-tech industrial applications. Apart from that, this project also involved with the exploration of low-cost but performance enhanced advanced semiconducting materials through introducing novel nano-materials synthesis techniques for energy storage applications.

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

1 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 was investigated in order to develop efficient and low-cost nano particle synthesizing methods. This finding has been extended to develop performance enhanced novel transition metal semiconductors based electrode materials.

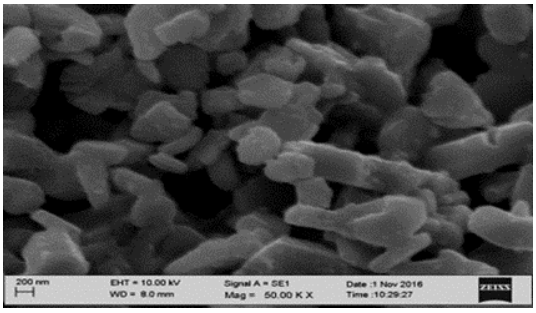

Fig 1. Morphology of synthesized materials

1 b. Development of materials for the electrolyte and electrode applications in upcoming Na-ion and Mg-ion batteries.

Na-Co-Mn-M-O_2 (M = Ni, Fe, Cu, Mg, Al …) based cathode materials and Na-Ti-M-O_2 (M = Mg, Al, Ba …) low-cost sodium transition metal oxides (TMO) materials have been synthesized using advanced synthesis techniques such as sol-gel, hydrothermal synthesis, solid-state sintering, wet chemical techniques such as Glycine nitrate and Pechini methods.

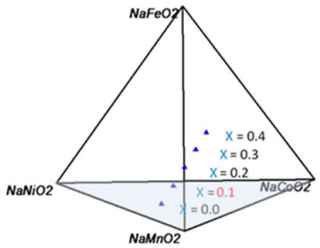

Fig. 2 Compositional details of the materials

1 c. Electrochemical performance investigations on Li-ion rechargeable batteries (LIB).

Our previous investigations have revealed local vein graphite to be promising anode material for the LIBs. Electrochemical performances of batteries fabricated with Sri Lankan graphite and TMOs

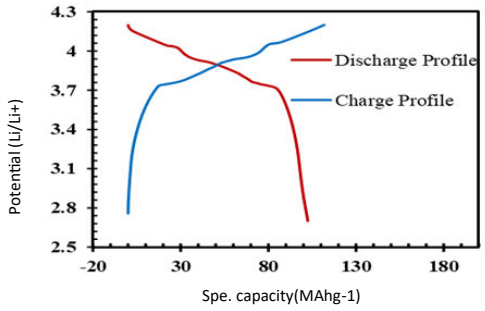

Fig. 3 Electrochemical performance of the cells

The discharge capacity of the cell was above 100 $mAhg^{-1}$ (104 $mAhg^{-1}$) at the current rate of 0.1C. This is a considerable achievement in the introduction of local graphite and locally improved TMOs to this type of important energy related technological application.

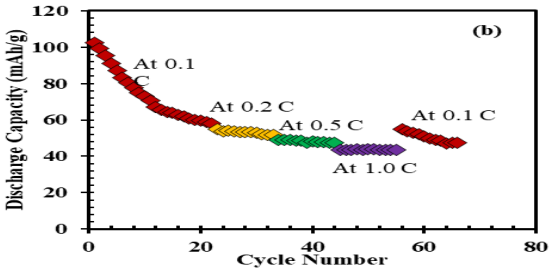

Fig. 4 Cyclic behavior of the battery

The average specific discharge capacities at C/10, C/5, C/2 and 1C rates were 75, 53, 47, 43 $mAhg^{-1}$, respectively. The initial discharge specific capacity decreases due to the formation of SEI layer on the electrodes. At high C rates, the discharge capacity slightly decreases and becomes steady. However, the relatively high first cycle discharge inefficiency is thought to be due to the mass unbalance of both electrodes. Further optimization is needed to enhance its performance.

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

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

The interlayer spacing of graphite is 3.35 Å, hence Li^+ ion can be electrochemically intercalated in between the layers of graphite. However, ions bigger than Li^+ cannot be effectively intercalated. Therefore, the use of graphite as an anode material in upcoming Na^+, K^+ and Ag^+ battery applications is limited.

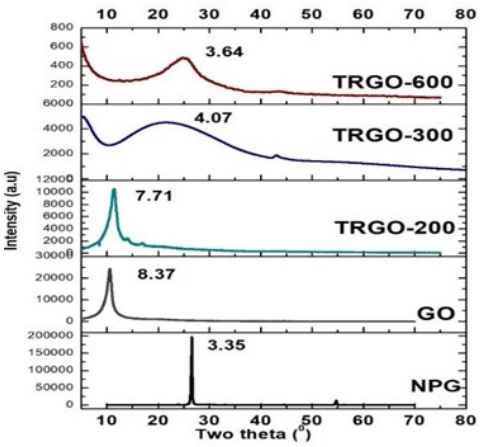

Fig. 5 Variations of the inter-layer space

In addressing this, a novel economical and highly practical method based on thermal annealing could be invented by our project to control the interlayer spacing, in a broader range, in graphite oxide derived from Sri Lankan vein graphite.

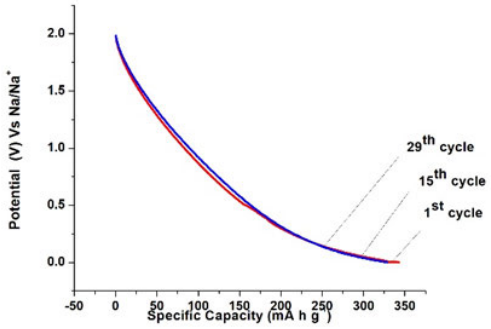

Fig. 6 Cycle-life performance of the cell

The developed graphite material prepared by this invented method was further investigated for one of its main intended application 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.

2 b. Deriving of nano-materials, nano-structured entities and composites from vein graphite.

Any considerable work on this field has not been taken place during this year mainly due to lack of research assistants and funds together with the difficulties arisen with the prevailing pandemic situation.

2 c. Development of local minerals and related materials for efficient water purification.

It has been well known that a number of local clay and biochar types are potential substrate materials for adsorbents using for contaminants removal from water sources. However, these pristine materials of their natural form are not efficient enough for this work. As a result, it is rare to find these local materials playing any significant role in the intended water treatment applications.

Fig. 7 Treatment columns

Therefore, enhancement of their activity/ performance aiming for the intended applications is a major necessity. In addressing this, six local clay types and two biochar types as starting materials have been investigated under this project to enhance their performance in removing inorganic contaminants in water resources.

This development took place mainly through thermal treatment and fabricating clay with charcoal into composites. The composite fabricated with clay and char fiber show good adsorption capacities for copper and arsenic species. This finding directs for novel possibilities of clay charcoal modifications to treat toxic metal ions contamination in water.

National Center for Advanced Battery Research (NCABR).

The National Center for Advanced Battery Research (NCABR) is operated under this Nanotechnology and Advanced Materials Project. This NCABR was stablished under a main research grant (Rs. 49.8 Millions) received from the General Treasury through the Cabinet Paper: No. 17/1907/16/038 2017-08-09 of Government of Sri Lanka. The Completion of the establishment and ceremonial opening of this center took place in January 2020

The NAABR is a dedicated central laboratory facility for battery related research and development work. The highest priority of this center is given to the development of Sri Lankan minerals to fabricate novel low-cost but high performing batteries, locally.

This central laboratory facility is open for local research groups working on battery/energy related applications to perform collaborative research. At present, our laboratory/testing facility ranges from materials synthesis, component fabrication, cell assembling to battery performance evaluation.

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Theoretical Physics & Computational Studies

In Theoretical Physics and Computational Studies Research Unit at NIFS, we use the tools of theoretical and computational physics to address, explain and understand the physical world surrounding us. This research unit consists of projects under the areas of foundations of quantum mechanics and Single Bubble sonoluminescence (Mysteries of Energy Focusing Phenomena). Specifically, the Quantum Physics Research Group is currently engaged in investigating fundamental aspects of Quantum to Classical Transition, Quantum chaos, Quantum Computing and Quantum non-locality.

- Quantum Physics & Applied Electronics

Prof. Asiri Nanayakkara

He received his BSc in Mathematics (University of Colombo); MS in Physics (Ohio University USA); PhD in Physics (Iowa State University, USA). He has been a postdoctoral researcher at University of Bristol (UK), Ames Laboratory (USA) and Supercomputer Computations Research Institute (USA). He has also worked as a computational Scientist at CRAY Research inc. (USA) before joining NIFS.

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Quantum Physics and Single Bubble Sonoluminescence

Quantum mechanics, quantum field theory and relativity together form the theoretical foundations of modern Physics. Even 100 years after its inception the fundamental aspect of quantum mechanics is one of the most dynamic areas of current physics research. In particular, fundamental research on Quantum Non-locality, Quantum Entanglement and Quantum to Classical Transition is not only very important in understanding the true nature of the quantum reality but also their existence has practical consequences, enabling much stronger forms of information processing, communication, and quantum computing.

The Quantum physics research Group at NIFS was initiated in January 2016 and is currently engaged in investigating fundamental aspects of Quantum to Classical Transition, Quantum chaos, Quantum Computing and Quantum non-locality.

In sonoluminescence research, we are mainly interested in understanding the light emission phenomenon using computational and theoretical techniques. We are currently developing software for realistic simulations of single bubble sonoluminescence and investigating light emission mechanisms using quantum mechanics.

Quantum Physics

One of the unique features of quantum systems is quantum non-locality due to entanglement. On the other hand, the processes of quantum decoherence can provide clues about the mechanism of wave function collapse and quantum to classical transition. Quantum decoherence and entanglement can be investigated both theoretically as well as numerically by means of quantum random walks that are the quantum counterpart of classical random walks. Further, quantum walks provide a testing ground for various aspects of decoherence, wave function collapse and quantum to classical transition.

In this research area, many investigations were carried out for generation and utilization of entanglement in multidimensional quantum random walks as well as multiparticle random walks. The multidimensional coin operators constructed by taking direct tensor products of one-dimensional unitary operators usually preserves entanglement if the initial coin state is entangled. Nevertheless, they do not generate entanglement unless the initial coin state is entangled.

Recurrence in quantum walks is termed when the walker returns to the origin with a nonzero probability and if the original coin state is also the same as the initial coin state then the quantum walk is said to have a full revival. In this research, with the aid of 2-D non-local coins, we were able to show that some four-state quantum walks can have full revivals with any even period and periodicity can be controlled with a slight change of a single parameter within the coin operator. We introduced a quantum scheme which can generate recurrence in n-dimensional. Under this scheme, a walker exhibits a periodic motion by returning to the initial position in equal time gaps. Periodic motion is maintained by launching interventions on the coin space during each cycle of the motion.

Further, we showed that for any given number of spatial dimensions, a coin operator can be constructed to generate a quantum walk having full revivals with any desired period. From the point of view of quantum computation and simulations, these coin operators can be useful in implementing quantum walks which oscillate between any two states with a finite periodicity.

Dechoherence in quantum systems was investigated using quantum walks. We introduced an analytically treatable spin decoherence model for quantum walk on a line that yields the exact position probability distribution of an unbiased classical random walk at all-time scales. This spin decoherence model depicts a quantum channel in which simultaneous bit and phase flip operator is applied at random on the coin state. Based on this result, we claim that there exist certain quantum channels that can produce exact classical statistical properties for a given one-dimensional quantum walk.

During 2020, a new Gedankenexperiment was constructed to challenge the results of the delayed choice double slit experiments carried out recently. The results will be published in the near future.

Single Bubble Sonoluminescence

Single-Bubble Sonoluminescence (SBSL) is observed when a single gas bubble, which is acoustically levitated in a liquid, undergoes nonlinear oscillations in synchrony with the applied sound field and emits sub-nanosecond flashes of light at the point of maximum implosion. As the bubble collapses, vibrational energy gets concentrated by at least a factor of 4×10^4 to produce flashes of light in the UV range. At the latter stages of the collapse, both the temperature and the pressure inside the bubble reach extreme values such as 20,000K and 3,500 atm, respectively. Also, the bubble wall reaches acceleration over 10^{11} g near the maximum implosion.

In water, the spectrum of SBSL fits blackbody radiation with surface temperatures in the range of 6000K–20 000 K for sound frequencies between 10 and 50 kHz. On the other hand, spectrum of SBSL of an isolated bubble driven at 1MHz sound frequency agrees well with thermal bremsstrahlung from a 10^6 K plasma.

Although stable SBSL was discovered over twenty -five years ago, the exact mechanism of light emission still eludes the scientific community. Many experimental investigations reveal that the spectrum of long-time stable water based SBSL is continuous and best fit by an ideal Planck blackbody spectrum. Puzzlingly, the reason behind the observation that SBSL emissions follow this Planck's law behavior is still not clear. Nevertheless, ideal blackbody models suffer from some serious inconsistencies. Especially, it has been experimentally observed that the pulse width of Sonoluminescence radiation is only weakly dependent on wavelength, contrary to what we would expect from an ideal blackbody which would result in much longer pulses at long wavelengths than in the short wavelength region. Further, the pulse widths predicted by blackbody models are usually much larger than the experimental values. Moreover, the derivation of Planck's formula assumes that many wavelengths of light fit into the blackbody. This condition is not satisfied by the SBSL bubbles as the hot spot is smaller than the wavelength of light that we measure.

Therefore, it is now widely believed that light emission region of SL bubble cannot be an ideal blackbody and it is nearly transparent to its own emission. The SBSL spectrum is now assumed to be the result of volume emission mainly due to thermal bremsstrahlung. However, bremsstrahlung view is baffled by the previously mentioned observation that SL is in many cases accurately matched by a blackbody spectrum, which implies an opaque emitter.

In order to investigate aforementioned inconsistencies, we first developed a computer simulation software based on hydro-dynamical model which assumes gas distribution in the interior of the bubble is uniform throughout the cycle. Based on the simulation, we developed a new surface emission model (NSEM) based on blackbody radiation. It was found that NSEM can accurately predict experimental SBSL intensities, pulse widths, pulse shapes, and nearly independent nature of pulse widths on the wavelength.

Our results further show that experimentally observed behavior of SBSL radiation on driving pressure and the expansion ratio can only be reproduced by NSEM and predictions made by models based on volume emission due to thermal bremsstrahlung contradicts the experimental results. Our results strongly suggest that the SBSL emission is mainly due to surface emission from a blackbody but not the currently accepted thermal bremsstrahlung.

This is a very significant result. However, more realistic computer simulations based on non-uniform gas models are required to remove any possible loopholes. Currently new software is being developed for realistic simulations.

In addition, during the covid-19 locked down period, UV light measurements were carried for Sri Lankan Army.

Key Publications

(1) Vibodha Bandara and Asiri Nanayakkara (2020). “A low-cost, portable biopotential monitoring system to study electrical activities of the human brain and body**” Eur. J. Phys.** 41, 065801

(2) Mahesh N Jayakody and Asiri Nanayakkara (2019). “Full state revivals in higher dimensional quantum walks” **Phys. Scr.** 94. 045101

(3) V. Bandara, P. Herath, A. Nanayakkara (2015). “Temperature dependence of singlebubble Sonoluminescence threshold in sulfuric acid: An Experimental study” **Physical Review E** 91, 06301

Natural Products & Food Chemistry

Many types of plants, plant products (fruits and vegetables) and microorganisms such as fungi contain bioactive components which are of benefit to humans. These have been consumed as food and some have been used for medicinal purposes for centuries. The scope of Natural Products and Food Chemistry unit of the NIFS is to study medicinal plants, natural products and functional food science. Under natural products project, studies are mainly focused on identifying bioactive secondary metabolites present in plant and fungal extracts, and in medicinal preparations. The preventive/therapeutic effects of these compounds are evaluated against chronic diseases such as diabetes and cardiovascular diseases. Nutritional Biochemistry project focuses on various aspects of functional and nutritional properties of foods and cover a wide area like functional and nutritional properties of food, food safety, and bioavailability of food to improve health and well-being of people. Food chemistry project focuses on exploring the application of food chemistry to add values to the under-utilized plant resources to address the national food security. The knowledge gained from these projects will eventually be used in the development of novel food products, food supplements and healthy foods with enhanced nutritional and functional properties.

- Food Chemistry
- Natural Products
- Nutritional Biochemistry

Prof. J.M. Nazrim Marikkar

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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.

Coconut (*Cocos nucifera)* is a tropical monocotyledon perennial crop belonging to family arecaceae. The germplasm of coconut in Sri Lanka consists of three varieties and fourteen different forms of coconut. Coconut testa is the brown colored thin outer covering of the coconut endosperm. It is an underutilized by-product in desiccated coconut industry, which is often used as animal feed. However, it has a great potential as a functional ingredient in food processing industry. Food chemistry project has taken initiatives to study and characterize coconut testa oil and its flour.

FTIR Spectroscopic Characterization of Coconut Testa Oil

Authentication is frequently employed to prevent fraud in food marketing. Here, the usefulness of the FTIR spectroscopy was investigated for authentication of coconut testa oil (CTO). Hence, the spectroscopic characterization of the CTO would be useful for authentication purposes. The overlay of spectra presented in Fig 1 compares the nature of vibrations displayed by CTO obtained from different coconut cultivars.

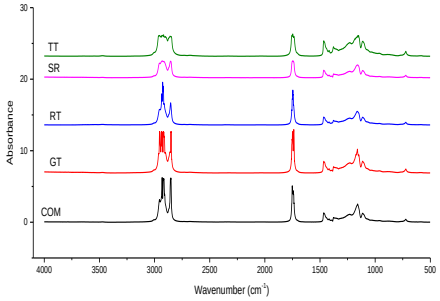

Fig. 1: FTIR spectral differences of coconut testa oil of different cultivars; TallxTall (TT); San Raman Tall (SR); Ran Thembili (RT); Gon Thembili (GT); Commercial hybrid (COM) within the range of 4000-500 cm^{-1}

As shown here, a series of spectral bands associated with different functional groups were identified for CTO. Although the overlay of spectra looks similar in their pattern, there were some variations in absorption intensities of several spectral bands. Spectra of all cultivars showed characteristic vibrational bands of organic functional groups associated with tri-acylglycerols molecules.

Although certain spectral regions exhibited few dissimilarities, the chemical groups representative of those spectral features were same. Particularly, the variability of the degree of unsaturation of the oil of different cultivars was responsible for intensity variations noticed in these absorption peaks. Results of the spectra characterization would stimulate further studies which would benefit authentication of CTO.

Particle Size Distribution of Coconut Testa Flour

An initiative was taken to utilize partially-defatted oil cake coming from coconut testa. The particle size distribution of coconut testa flour (CTF) of different cultivars is compared as shown in Fig 2.

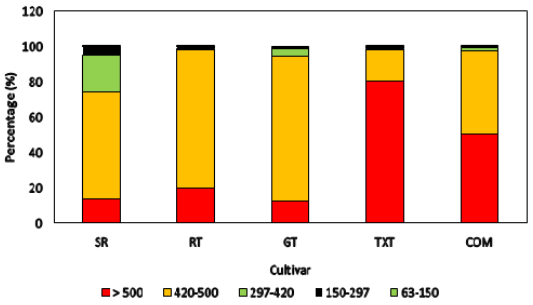

Fig. 2: Particle size distribution of coconut testa flour of different coconut cultivars

Significant relationships were existed [F (16, 50) = 6288.81, p = 0.0001] among different cultivars with regard to particle size distribution. For all cultivar types, no significant differences were noticed for particle size ranges of 63-150µm and 150 –297 µm, but a significant difference was noticed for particle size range of 420–500 µm. SR and rest of the cultivars displayed significant difference for particle size range of 297–420 µm meanwhile COM and TxT displayed significant differences for particle size >500 µm.

Anti-diabetic Effect of Coconut Testa Flour

Diabetes type 2 can be better managed through partial inhibition of enzymes, α-amylase and α-glucosidase which are responsible for the breakdown of oligosaccharides and disaccharides into monosaccharides. The objective of this study was to evaluate the α-amylase and α-glucosidase enzyme inhibitory potential of partially defatted testa.

Samples of CTF from five local cultivars were sequentially extracted with hexane, ethyl acetate and methanol. The results of in vitro- α-amylase assay of CTF crude extracts are presented as IC_{50} values in Table 1. Results showed that strong α-amylase inhibitory activities were found only among MeOH extracts of all cultivars while weak inhibitory activities were observed among other two extracts.

Table 1: IC_{50} values of CTF crude extracts for inhibition of α-amylase activity

Cultivar	IC_{50} value (ppm)		
	Hexane	EtOAC	MeOH
COM	Wk	Nd	3994.94 ± 3.60 [d]
GT	Wk	Nd	143.38 ± 10.43 [b]
RT	Wk	Wk	599.57 ± 12.41 [c]
SR	Wk	Wk	87.35 ± 2.65 [a]
TT	Wk	Wk	80.09 ± 4.67 [a]

The results of in vitro- α-glucosidase assay of CTF crude extracts of hexane, ethyl acetate and methanol are presented as IC_{50} values in Table 2.
According to Table 2, all crude extracts of different cultivars exhibited inhibitory activity against α -glucosidase. Different cultivars showed differences in IC_{50} values in their crude extracts resulting in varied potential enzyme inhibitory effect. The inhibition of α-glucosidase activity was found to be much stronger than the inhibition for α-amylase activity in all extracts.

Table 2: IC_{50} values of CTF crude extracts for inhibition of α-glucosidase activity

Cultivar	IC_{50} value (ppm)		
	Hexane	EtOAC	MeOH
COM	18.84 ± 0.41 [b(A)]	56.64 ± 3.37 [b(A)]	403.32 ± 17.24 [b(B)]
GT	8.38 ± 0.52 [a(A)]	8.56 ± 0.30 [a(A)]	22.53 ± 0.26 [a(B)]
RT	40.12 ± 1.76 [c(B)]	9.78 ± 0.73 [a(A)]	70.43 ± 6.31 [a(C)]
SR	61.18 ± 2.21 [d(C)]	12.58 ± 0.37 [a(A)]	25.39 ± 1.05 [a(B)]
TT	65.91 ± 3.92 [d(C)]	7.82 ± 0.40 [a(A)]	36.51 ± 0.84 [a(B)]

Current MPhil Students

Ms. S.S.K. Marasinghe
Ms. R. Gunarathne

Key Publications

Marikkar, J.M.N., R. Nagaraja, K.M.S. Somawathie, H.P.T.D. Hewapathirana, C. Yalegama, P. Littardi and E. Chiavaro (2020). Effect of coconut testa flour on cookie characteristics. *Ital* ***J Food Sci****.* 32: 459–471.

From L to R : Prof. JMN. Marikkar, Ms. KMRU. Gunarathne

Ms. K. M. R. U. Gunarathne

Rasika Gunarathne is a M. Phil Research Assistant in the Food Chemistry project at the National Institute of Fundamental Studies (NIFS). She received her B.Sc. in Food Science and Technology from University of Peradeniya in 2019 and joined NIFS the same year. Her research focuses on the bioactivities and prebiotic potential of coconut testa flour of selected Sri Lankan coconut cultivars. Her research interests include food chemistry, food biochemistry and food microbiology.

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Natural Products

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 the identification of bioactive extracts and compounds from natural sources, as potential sources for control of human and plant diseases. Research activities have been 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 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 using chromatographic techniques to isolate bioactive compounds. Structures of isolates are determined by detailed analysis NMR, MS spectral data. Partial syntheses of isolates are carried out to enhance the bioactivity of isolates.

Research activities of the Natural Products Project of the NIFS are mainly on the following four 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

Search for eco-friendly new weedicide from microbial metabolites Endophytes, microorganisms that reside in the tissues of living plants, have been attracting a growing interest as potential sources of novel natural products for exploitation in medicine, agriculture, and industry. Weeds are serious threats to agriculture, the natural environment and primary production industries. Weeds include invasive plants, which often displace native species, contribute to land degradation, and reduce farm and forest productivity causing damage to natural landscapes, agricultural lands, waterways and coastal areas and environmental and social impact. More specifically, fungal toxins and their derivatives have also been considered as sources of novel and safe natural herbicides. Endophytes are cultured outside their host, they produce secondary metabolites, which can show bioactivity.

Endophytic fungi and pathogenic fungi were isolated from *Acalypha indica* (Kuppameniya), *Colocasia esculanta (*AlaKola), *Mikania micrantha* (Wathupalu), *Vernonia cineria* (Monarakudumbiya), *Centella asiatica* (Gotukola) and *Cardiospermum halicacabum* (Welpenela) following standard triple sterilization method. Thirty one fungal species were isolated from above plant species and they were sub cultured to obtain pure cultures. Each endophytic fungus (31) isolated from different plant species were cultured in five flasks containing 400 mL of Potato Dextrose Broth (PDB) medium. Flasks were shaken continuously on laboratory shaker after ten days of inoculation until the day of extraction. After five weeks of incubation broth was filtered.

Mycelium was sequentially extracted in to EtOAc followed by MeOH. Freshly filtered broth was sprayed to 3 weeks older cucumber seedlings (*Cucumis sativus*). Observation were taken daily until 7 days. Only three fungal broths gave necrotic leaf symptoms in the broth spraying assay which were fungus (VC/K) isolated from a *Vernonia cineria* (Monarakudumbiya) leaf part, fungus CA/A isolated from a *Centella asiatica* (Gotukola) leaf part and fungus CH/F isolated from a *Cardiospermum halicacabum* (Welpenela) leaf part. Seed germination bioassay was performed with the inhibition of lettuce seed germination. Two EtOAc extracts (VC/K originated from *Vernonia cineria* and AI/B originated from *Acalypha indica*) showed 90% inhibition at 1000 ppm for lettuce seed germination inhibition assay. EtOAc extract of CA/A originated from *Centella asiatica* showed 100% root inhibition at 250ppm with IC_{50} value of 23.7ppm and 55.8ppm for root and shoot inhibition respectively. The EtOAc extract of CH/F originated from *Cardiospermum halicacabum* showed 100% root inhibition at 1000 ppm with IC_{50} value 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 extracts of CH/F at 1000ppm and for CA/A at 250ppm where observations were taken for three days. Fungi which showed positive results for lettuce seed germination inhibition bioassay and broth spraying bioassay were grown in large scale (each fungus in 60 flasks containing 400 mL of PDB medium). Fungal extracts were obtained after following previously described methodology. EtOAc extracts of fungus VC/K and AI/B were subjected to several chromatographic techniques including column chromatography and HPLC, in order to obtain seven and five pure compounds respectively.

Following compounds (1R,5R,6R)-5,6-dihydroxy-3-(hydroxymethyl)-2-oxocyclohex-3-enyl-2-hydroxy-6-methylbenzoate(**1**), (1S,5R,6R)-5,6-dihydroxy-3-(hydroxylmethyl)- 2-oxocyclohex-3-enyl-2-hydroxy -6-methylbenzoate(**2**), 6-methyl salicilic acid(**3**), PF1052(2,4-pyrrolidinedione)(**4**), epoxydon (**5**) furnished the fungus from *Vernonia cineria* while 19,20-epoxycytochalasins C (**6**), (E)-Methyl 3-(4-methoxyphenoxy)propenoate (**7**), (6E,8E)-9-(3-hydroxy-2-(hydroxymethyl) phenyl)nona-6,8-diene-2,4,5-triol(**8**), clonostachydiol (**9**) furnished the fungus from *Acalypha indica.*

Further the NSF and NRC funded research projects titles (1) 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 form the medicinal plants *Coccinia grandis, Costus speciosus* and *Gymnema sylevestre* used in indigenous medicine for treatment of diabetes mellitus and possible commercial applications (iii) Microbial Metabolites - a source for development of eco-friendly new weedicides are going on.

Plant secondary metabolites and LC-MS profiling of bioactive extracts is another research project. Under this project three varieties of onions (*Allium cepha*) and garlic (*Allium sativum*) were profiled and its antioxidant activity, α-amylase, α-glycosidase activity and lipase activity were determined. The LC-MS studies on the extracts showed the presence of the quercetin in significantly high amount in Bombay onion with dark purple peel.

Ph.D / M.Phil. Students

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Upesha Siriwardane - M.Phil. Student
Jayani Kalinga - M.Phil. Student

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Key References:

1. Kehelpannala, C., Rathnayake, G.R.N, Dissanayake, D., Kanatiwela, D., Kumar, N.S., Adikaram, N., Jayasinghe, L., Araya, H., Fujimoto, Y. (2021). Determination of the absolute stereochemistry of (+)-solaniol, ***Chemical Papers*****,** 1-3.

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Prof. Nimal Adikaram

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Postharvest diseases of horticultural fresh produce

Postharvest diseases & Disorders 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 project, funded by the NRC, Public Private Partnership program, investigated disorders and fungal diseases, in ripe mango cv. TomEJC adversely affect the export/market quality. The aim is to understand the cause and factors affecting the disorders & diseases, the mechanism of development and formulate appropriate management practices.

Internal Pulp Browning (IPB)

The main symptom of the disorder is browning of pulp, just outside the seed, on both sides. There was no significant difference in pulp firmness between healthy and IPB affected pulp. Fruits showed IPB were at overripe stage. Externally, the affected fruits did not show any sign of the disorder and symptoms could only be seen when the pulp is exposed.

In-fruit germination of seed

In the cv. TomEJC, the seed starts germination while within the harvested fruit. Every fruit with IPB symptoms examined, invariably had a germinated seed.The seed tends to swell during germination increasing its thickness (from 9.94 ± 0.44 to 19.19 ± 1.59), twice as much as the thickness of ungerminated seed. There was no significant ($P > 0.05$) change occurred, in seed length or width during germination. Germination process increases the seed volume more than twice, on average, from 34.6 cm^3 to 73.4 cm^3.

The study revealed that the seed germination while within the fruit triggers IPB. The damage to cells in the pulp begins with the start of seed germination. Increased seed thickness ruptures a few layers of pulp tissue immediately outside the seed coat, both sides of the seed, damaging the already softened pulp due to ripening, and resin canals. Phenolic compounds, released from damaged resin canals, undergo oxidization by PPO enzyme released from damaged cells forming polyphenols and pulp browning. A direct correlation exists between the extent of seed germination and the degree of IPB development.

When germination was at Scale 1, the seed swells only slightly, and tissue damage is lesser. When the seed has germinated fully (Scale 3), seed thickness is doubled, causing intensive IPB. On the other hand, not all fruits that had germinated seeds have shown IPB symptoms.

Association of a bacterium with IPB

A slow-growing, Gram negative, non-motile bacterium was consistently isolated from IPB affected fruit pulp and identified as *Pseudo- monas* sp. using selective media. However, there was no evidence for a definitive role for the bacterium to play in IPB development.

Wet weather & IPB development

Heavy rainfall was identified as a contributing factor for IPB development. Rainfall data in the area in which Rajarata Farm (Ellawala Hort. Ltd.) is located were collected for a period of 7 years, commencing from the year 2011. The disorder was first observed in 2012. The annual rainfall pattern recorded over the period showed that heavy downfall had been a regular feature of the fruit season from September – December. The disorder occurred exclusively during the fruit season that extends from September to January in the year 2012, 2015, 2016, 2017 and 2018. The figures showed a direct link between the incidence of IPB and heavy rainfall showing that rainfall might also be a contributing factor in the development of IPB symptoms, in addition to the germination of the seed within the fruit.

Wet weather conditions are likely to increase moisture content of fruits closer to harvesting maturity. However, average weight of fruits harvested within the two seasons, mid-year (mostly dry) and the year-end season with torrential rain, was not significantly different. Excessive water may increase osmotic potential of mango pulp cells and enlarge in size making more prone to self-disruption while stimulating seed to germination within the ripening fruit. The commencement of in-fruit germination of the seed is most likely triggered by water stress.

Pitting disorder

Pitting disorder occurs in the peel of different fruit species. Pitting in mango cv. TomEJC was diagnosed for the first time in Sri Lanka in 2017. Pitting produces striking symptoms on mango cv. TomEJC as small, circular to angular, shallowly concave, depressed areas isolated and scattered in the peel. The margins of pitted areas were light brown with clear edges, surrounded by about 3 mm thick, pale yellow color, diffused area. The disorder was not observed in fruits before or at harvest but appeared in certain fruits within hours or up to a day after mature fruits have been harvested.

A closer examination of pitted areas externally, revealed that, although pitting surface is depressed, the cuticle and epidermis in the affected peel area were still intact as in the healthy fruit peel. The edges bordering pitting areas were broken at certain points. A cross section (microtome) cut through healthy fruit peel, examined under light microscope after staining, revealed the tissue arrangement, first the cuticle, followed the epidermis as outermost layers followed by parenchyma and collenchyma layers. Tannin cells and resin canals were also present in-between parenchyma cell layers. A similar section, taken through a peel with pitting area and observed under light microscope after staining, was different from healthy tissues in terms of tissue composition and arrangement. A cross section from pitted tissues had a large cavity between the cuticle and collenchyma layers, resulted from breaking down of several cell layers. In addition, the collenchyma layers below the cavity had also collapsed to form a thin belt of reminiscent cell skeletons of damaged cells.

Association of element/s in pitting development

Collapsing of tissue layers might be associated with 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 some elements in pitted tissues compared to 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, 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 season November 2017 – January 2018 showing that the disorder was common in harvested fruits var. TomEJC. Postharvest washing of fruits with water or detergent solutions was found to result in lenticel darkening in TomEJC mangoes. The increased LD in the season from November 2017 – January 2018 could be related to the postharvest washing of fruit with water or detergent solutions followed by a relatively shorter drying time. In the season, May – July 2018, the practice of washing harvested fruit with water or detergent was avoided. Only the fruits that were meant for processing were washed with water.

Since lenticel discoloration is a cultivar dependent discoloration, the density of lenticels might play a role in the disorder. Among the local varieties studied, cv. TomEJC had the highest lenticel density, making it more 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. Brushing of mango fruit was considered as the postharvest practice which makes the most damage to lenticels, followed by soap washing. Hot water treatment is another postharvest practice that could increase LD.

Stem-End Browning (SEB)

Stem-end browning (SEB) is a postharvest disease in ripe mango var. TomEJC, SEB Symptoms develop during ripening of harvested fruit. Browning appears first around the stalk which spreads with the advancement of ripening, covering the upper one-third to the upper half the fruit peel. SEB appeared dark brown, light brown or pale grey color. Superficial pulp below the affected peel also turned brown. Neither the affected peel nor the pulp tissue became softened.

Fungi were isolated from fruits showing stem-end browning and the association of 12 species of fungi with SEB was established. First, the fungi isolated were characterized using morphological characteristics to genus level.

Some of the fungi were also isolated and identified from the stalk of healthy and diseased fruit and developing or harvested fruits. Pathogenicity of all isolates was tested by inoculating freshly harvested, healthy fruits var. TomEJC with drops (20 µl) of conidia on to the marked areas of the stem-end region. After incubating for 10 days, the symptoms that appeared on inoculated fruits were studied. The fungi were re-isolated from diseased tissues and compared with original isolates used for inoculation.

Homogenous fungal colonies were used for DNA extraction. The fungal pathogens isolated were identified to species level using multigene DNA sequence analyses. DNA was extracted from the mycelium using a commercial DNA isolation kit. PCR products were sequenced.

Field infection of developing fruits

The study revealed that the fruits harvested were already infected, in the field. This was confirmed as most of the fungi were isolated from developing fruits, at any stage between 2 to 12 weeks old fruit, confirming that infections have occurred in the field.

Management

Certain cultural practices, aimed at reducing the field inoculum, and application of a pre-harvest fungicide from flowering were recommended. A postharvest fungicide Amistar (Azoxystrobin, Syngenta) was recommended, after screening against SEB fungi & a series of fungicide dip trials, as an option for the wet season.

Mycology work

Mycological studies continued at the Natural Product Division NIFS in collaboration with the Department of Botany, University of Peradeniya since 2017. Fungi pathogenic, endophytic and epiphytic in plants, fruits and other habitats were identified at species level, using multi-locus DNA sequence analyses.

A checklist consisting 400 species of “Plant Pathogenic fungi and Oomycota in Sri Lanka”, was prepared & published in 2020. For the first time, two groups of Sri Lankan fungal flora, (i) Fungi associated with plants (1,139 species) and, (ii) Agaric flora of Sri Lanka (345 species) were added as a Chapter to the “The National Red List 2020”.

Leucocoprinus birnbaumii was revisited in 2020, 100 years after its first record in Ceylon, and *Helvella crispa* was recorded for the first time in the country adding a new species and a genus to the fungal flora. Both findings were published in 2020. An authenticated collection of fungi isolated and characterized is maintained together with digital images of fruit bodies, asexual and sexual reproductive structures of the fungi collected .

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Nutritional Biochemistry

Nutritional Biochemistry project focuses on various aspects of functional and nutritional properties of foods. It covers a wide area like functional and nutritional properties of food, food safety, and bioavailability of food to improve people's health and well-being.

Functional and nutritional properties of food: Under this research theme, studies are done to assess the antioxidant, enzyme inhibition (amylase, glucosidase, and lipase), radical-induced DNA damage prevention, and identification of active compounds. Besides, *in vivo* and cell culture experiments are also done for further confirmation of functional properties. There are three ongoing studies; assessing nutritional, functional, and physicochemical properties of some selected Ayurvedic plants, different cultivars of mushrooms, and differently processed *Artocarpus nobilis* (Wal dhel/Badi del) seeds.

Bioavailability and bioaccessibility of food bioactive compounds: The amount of bioactive compounds or nutrients actually available for absorption after gastro- intestinal digestion is different from what is available in undigested food components, and this is known as “bio-efficiency.” Bio-efficiency is one of the essential characteristics of foods, in particular functional foods and is quantitatively expressed by assessing bioavailability, bioaccessibility, and bioactivity. These concepts are studied using *in vivo*, *ex vivo*, and *in vitro* methods and are quantitatively expressed using different units of measurements. In this particular study, the bioavailability and bioaccessibility of antioxidant compounds in raw and processed legumes were studied. Further, the effect of boiling and simulated digestion on the prebiotic activity of legumes were studied.

Nutritional and biochemical properties of raw and processed *Artocarpus nobilis* (Badi Del/ Wal Del) seeds

Current knowledge on the effect of nut consumption on preventing diet-related non-communicable diseases is a well-established factor. Mainly it is associated with lowering the risk of coronary heart disease and prevention of type2 diabetes. Although many countries produce specific local brands of nut-based products at a competitive price, Sri Lanka is yet to explore the physicochemical properties of naturally available nuts.

Artocarpus nobilis Thwaites (Ceylon breadfruit/ Waldel/ Badi del)(Fig.1) is a native underutilized tree nut in Sri Lanka with a distinct flavor. The present study investigates the nutritional and biochemical properties of raw and processed *Artocarpus nobilis* seeds using *in-vitro* and *in-vivo* assays. Seeds were subjected to three different processing methods; roasting, microwaving, and boiling. According to the research findings, this seed can be characterized as an energy-dense food that contains a higher amount of carbohydrate (59.48±1.10), a moderate amount of lipid (26.45±0.86), and protein (11.73±0.25). As same as other commercial nuts, a higher level of healthy mineral such as magnesium (1176.12±67.83 µg/g), potassium (5838.18±138.18 µg/g), and calcium (567.29±21.55 µg/g) along with low sodium content (30.15±0.93 µg/g) was reported in raw *A. noblis* seed from the ICP-OES analysis

Fig.1: *Artocarpus nobilis Thwaites seeds*

Defatted methanolic extract of *A. nobilis* showed a significantly higher total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity than most of the commercially available nut types: pistachio, almond, and cashew nut.

Phenolic profile analysis of raw, boiled and in-vitro digested legumes using LC/MS

In order to exert the exact health benefits, polyphenols should be released from the food matrix and get bioavailable. However information on bioaccessibility and bioavailability of phenolic compounds in legume is limited. In this study an *in vitro* gastrointestinal model using synthetic enzymes was used to mimic the *in vivo* physiological steps of digestion. For each sample, bioavailability/bioaccessibility of phenolic compounds were investigated to study the potential effect of the processing on the release of phenolic compounds.

Using the LC-MS/MS five phenolic compounds namely Quinic acid,(Fig.2), Quercetin, Rutin, Ferulic acid and Apigenin (Fig.3) were identified and quantified in raw, boiled and bioavailable fraction (fraction inside the dialysis bag) of legumes. When considering the raw legumes, highest Rutin (94.04mg/g) and Quercetin (149.22mg/g) content were observed in cowpea (Waruni) while mung bean contained the highest Apigenin (87.09 mg/g) content. In general, boiling has significantly reduced ($p<0.05$) the content of phenolic compounds in all tested legumes. However, bioavailable fraction of boiled chickpea showed an increase ($P<0.05$) in phenolic compounds observed compared to bioavailable fraction of raw chickpea. Overall, results show only a small fraction of phenolic compound is bioavailable to have implications in human health.

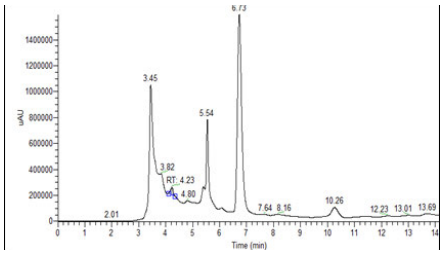

Fig.2:*Quinic present in boiled Horse gram*

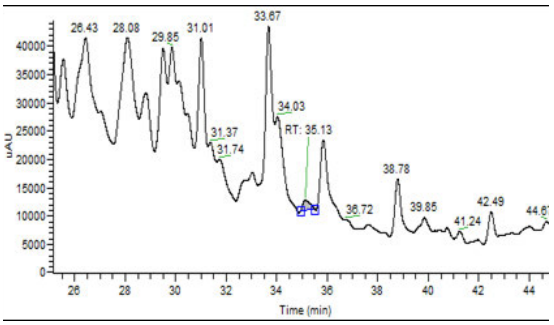

Fig.3: *Apigenin Present in raw Chickpea*

Effect of boiling and *in-vitro* simulated digestion using Synthetic enzymes on Fermentative properties

Legumes are known to contain a significant amount of resistant starch, dietary fiber and oligosaccharides which can modify the composition and function of gut microbiota. Fermentative properties of selected legumes (using synthetic enzyme digestion and pure bacterial culture fermentation) displayed that simulated digestion differently modulated the fermentation properties of raw and boiled legumes. Among all five tested legume samples, boiled chickpea could be considered as the best prebiotic candidate considering both Bifidobacterium and Lactobacillus proliferation ability. Boiled Mung bean, boiled chickpea, and boiled Cowpea (*Waruni)* may be more suitable than their raw forms in preparing prebiotic food.

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Key Publications

1. Deen, A., Visvanathan, R., Wickramarachchi, D, Marikkar, J.M.N**.,** Nammi, S, Jayawardana, B.C., and Liyanage, R. (2020). Chemical Composition and Health Benefits of Coconut oil: An Overview. **Journal of the Science of Food and Agriculture**, https : // doi. Org / 10. 1002/ jsfa.10870.

2. Rizliya, V., Qader, M., Jayathilake, C., Jayawardana, B.C., Liyanage, R**.,** and Sivakanesan, R. (2020). Critical review on conventional spectroscopic alpha-amylase activity detection methods: merits, demerits and future prospects. **Journal of the Science of Food and Agriculture,** 100(7), p.2836-2847.

3. Wimalaweera, U., Deen, A., Visvanathan, R., Sewwandi, S.M., Wickramanayeka, S., Wickramaarachi,D., Marikkar, J.M.N. N., Ratnayeka, I., Jayawardana, B.C., Liyanage**,** R. (2020). Comparison of fermentation properties in raw and boiled legumes after simulated digestion. **Ceylon Journal of Science,** 49(4), p.403-408.

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Microbiology & Carbon Sequestration

In the evolution of the Earth, formation of the lithosphere preceded that of the biosphere and even today the existence of plants depends largely upon soil which provides the substrate for anchorage and most of their nutrients. Soil nutrient supply is sustained by cycling of water, carbon, nitrogen, sulfur etc. and these processes are mediated by soil microorganisms. Studies carried out by this cluster are aimed first at understanding complex network interactions among the variables, and then applying the knowledge gained to sustaining and improving soil fertility by manipulating the role of microorganisms in nitrogen fixation, carbon sequestration and enhancing root growth and nutrient uptake through the introduction of beneficial microbial communities in biofilm mode. Research work is also directed towards microbial generation of bioenergy to circumvent the use of environmentally damaging fossil fuels.

- Microbial Biotechnology
- Microbiology & Soil Ecosystems
- Rhizobium Project

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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 75,000 acres in the country with a chemical fertilizers (NPK) cut down up to 50%, while increasing crop yields between 10-40%. It is also used in 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.

Stabilization of sequestered paddy soil carbon with the application of Biofilm biofertilizer

After the green and industrial revolutions, emission of carbon (C) to the atmosphere at higher rates has been reported to have caused global warming and climate change. Pulling back C from the atmosphere and storing it in the soil, thus confining its return back to the atmosphere is accomplished by the process called soil carbon sequestration (SCS). In the phase of degradation of natural ecosystems like forests by deforestation, frequent fire, etc., world agricultural lands with innovative biotechnological methods might play a crucial role in SCS. According to our previous studies, it has been proven that the Biofilm biofertilizer (BFBF) is capable of reducing chemical fertilizer (CF) use up to 50%, while increasing average grain yield by 20%, and also enhancing SCS up to 70% in lowland paddy cultivation, thus acting as an eco-friendly ameliorator in agriculture. However, the potential of stabilizing the sequestered soil C (SSC) with the application of BFBF is yet to be revealed. Therefore, a study was designed to evaluate the organo-mineral interactions (complexation) of paddy soils with reference to the BFBF application. The BFBF practice was compared with the farmers' current practice of chemical fertilizer (CF) alone application in two consecutive, uniform plots (each ca. 0.4 ha) of 25 representative locations in four districts having ca. 450,000 ha of paddy cultivation, during three consecutive seasons in Sri Lanka. Attenuated total reflectance Fourier-transform infrared (ATR-FTIR) spectroscopy of the soils was done to evaluate the organo-mineral interactions of SSC. The FTIR spectrographs of each treatment showed characteristic absorption banding patterns in the frequency range of 800–4000 cm^{-1} with prominent diagnostic features (Fig. 1). Wave number positions (3696, 3619, 3435, 1709, 1630, 1611, 1380, 1085, 1034, and 780) and assignments of mineral and/or organic functional groups were analyzed. The results showed that there are strong organo-mineral interactions in the soil C of the BFBF practice over the farmers' CF practice. Further, organic matter in the soils of the BFBF practice had more aliphatic and carboxylic C with spectral characteristics resembling microbial metabolites than the soils of the farmers' CF practice. Therefore, the BFBF practice can be concluded as an eco-friendly sustainable method to replace the farmers' current practice of CF alone application.

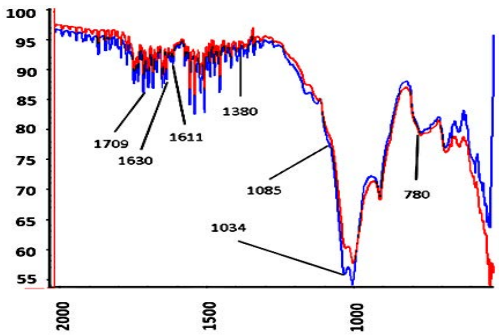

Figure 1. FTIR spectra with specific wave number positions indicating increased soil organo-mineral complexation of BFBF practice (blue) over farmers' practice (red).

Effect of biofilm biofertilizer on antioxidant activity of rice grains

Rice is the staple food and energy source in Sri Lanka. It is also an important source of minerals, vitamins, fiber and other bioactive compounds. It is evident that rice antioxidants influence the cellular redox status of human and animal plasma, which could offer protection against diseases associated with oxidative stress like cancer, or could potentially reduce the burden of the diseases. Attention has recently shifted to using antioxidant -rich extracts from rice. Rice antioxidants may exert health-promoting effects in a variety of ways. There is a shortage of information about the effects of biofertilizer on antioxidant composition of rice grains, but the available evidence suggests that greater concentrations of antioxidants are found in organic, traditional rice than in conventional rice. Therefore, this study investigated the effect of Biofilm biofertilizer (BFBF) on antioxidant capacity of conventional rice grains (varieties Bg 358, Bg 350, Bg 300, At 373, At 362 and At-311). Grain samples were collected from farmer-managed paddy fields under our guidance and supervision, where the farmers' maintained two consecutive, uniform trial plots for 100% CFs (NPK) only, and BFBF + 50% CFs (NPK) in rice growing areas of Sri Lanka, and they were analyzed to determine Total Antioxidant Capacity (TAC). It was observed that the BFBF practice significantly increased the rice grain TAC over 100% CF practice ($P < 0.05$). Thus, it is concluded from this study that we can convert the conventional rice in to healthier, medicinal rice with the application of BFBF.

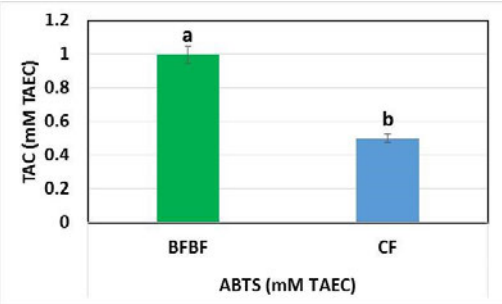

Figure 2: Rice grain Total Antioxidant Capacity (TAC) in BFBF and farmers 100% CF practices, as evaluated by ABTS method.

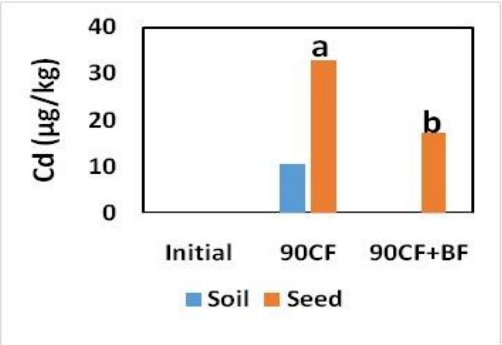

Figure 3: Cadmium concentration in paddy soil and rice seed with the application of CF alone (90CF), and CF with BFBF (90CF+BF) at harvesting stage. Soil Cd levels in the initial soil and 90CF+BF treatment were below the detection limit of ICP-OES used.

Remediation of heavy metal contaminated paddy soil using Biofilm biofertlizers

In this preliminary study, how does the application of BFBF help to remediate two toxic heavy metals Cd and As in paddy soil system was analysed in comparison to farmers' CF alone practice. Results showed that the application of CF alone increased the exchangeable amounts of the two toxic heavy metals in the paddy soil. However, the BFBF application locked high amounts of the heavy metals in the soil, thus minimizing their absorbance to the plant. Therefore, the BFBF use significantly reduced rice seed Cd concentration in particular, in comparison to that of the CF alone application ($P < 0.01$). Moreover, the BFBF lowered soil pH moderately, which led to bio-precipitate the heavy metals with the microbial action.

As such, this study shows that the application of BFBF minimizes the possible health risks of long term rice consumption.

M.Phil/Ph.D Students:
Ms. S.W. Meepegamage,
Ms. A.T.D. Rathnathilaka,
Mr. M. Premarathna.

Key publications:

1. Functional heterogeneity of metabolites excreted by fungal and bacterial biofilms and their effects on seedling growth. Singhalage, I.D., **Seneviratne, G.** and Madawala, H.M.S.P., 2020. *Ceylon Journal of Science*, 49, 13-19, 2020.

2. Biofilm mediated synergistic degradation of hexadecane by a naturally formed community comprising *Aspergillus flavus* complex and *Bacillus cereus* group. Perera, M., Wijayarathna, D., Wijesundera, S., Chinthaka, M., **Seneviratne, G.** and Jayasena, S . *BMC Microbiology*, 19, 84, 2019, [SCI Exp, IF: 3.287].

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Prof. Renuka Ratnayake

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Microbiology & Soil Ecosystems

Microbial cellulases have shown potential application in a wide range of industries including biofuel, pulp and paper, textile, laundry, food and feed industry, agriculture etc. The present project focused on studying the potential applications of enzyme extracts obtained from locally isolated cellulolytic microorganisms in different value added products and processes. Research conducted so far indicated that locally isolated microorganisms and their enzymes can be effectively used in industrial processors to replace commercially available high cost enzymes . Another study has been initiated to investigate the genetic diversity of cyanobacteria in different water bodies of Sri Lanka with their taxonomical identification, nutrient profiling and toxin analysis. The project also focuses on the establishment and maintenance of cyanobacteria culture collection which facilitates the preservation and conservation of pure cyanobacteria strains present in different types of water bodies and stress conditions in Sri Lanka not only for the academic and industrial research but also for future reference.

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. The potentiality of coastal ecosystems such as mangroves and intertidal saltmarshes will be 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. 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 stocks in soil and preparation of GIS based map are main outcome of this project. Kandyan home garden systems have also been studied for soil C sequestration potential.

Microbial cellulases: the potential application in biofuel production, textile industry and agriculture

The potential use of cellulolytic microorganisms isolated from natural environment in cellulosic biofuel production, dye removal from denim and damping-off disease control in tomato were evaluated. A novelty of the study was the effective use of *Trichoderma* spp. + *Candida* spp. co-cultures in cellulosic bioethanol production while *T. hamatum* + *C. parapsilosis* co-culture gave the highest ethanol yield (5.32%). The evaluation of sugarcane bagasse pretreatment and saccharification potential of fungal isolates revealed a combination of *Earliella scabrosa* and *A. niger* most efficient in performing the process. Furthermore, *T. hamatum, A. niger, Penillicum* and their cellulase enzyme mixtures efficiently removed indigo dye from denim fabrics. Moreover, *T. hamatum* and *A. niger* crude enzyme extracts were inhibitory against damping-off disease causing *Phytophthora* sp. The key findings of the study confirmed and emphasized the potential use of cellulases extracted from locally isolated fungi; *Trichoderma* spp., *Aspergillus* spp. *Penicillium* spp. monocultures and high efficiency of their co-cultures in carrying out industrially important activities.

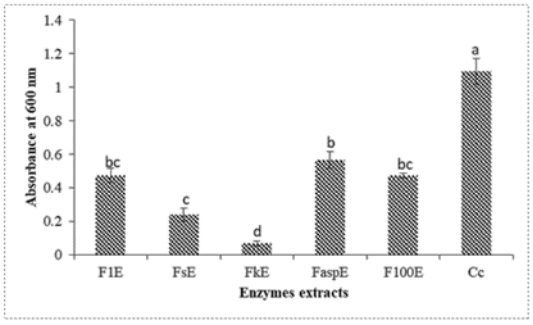

Figure 1: Denim dye removal potential of fungal isolates

Investigation of genetic diversity of cyanobacteria in different water bodies of Sri Lanka with their taxonomical identification, nutrient profiling and toxin analysis

The study focuses on genetic diversity evaluation of cyanobacteria in different extreme ecosystems in Sri Lanka and their potential applicability in nutrient based industry. More than 100 monocultures were isolated and morphologically Characterized from salt marshes, mangroves, hot water springs and lagoons.

Based on the morphological characterization, salt marshes showed the highest cyanobacteria diversity with the highest abundance of *Leptolyngbya* sp. As a step for cyanobacteria conservation in Sri Lanka, a cyanobacteria specific culture collection was established and maintained with 120 isolates from extreme environments and 100 freshwater isolates. Some isolates were molecularly characterized while others are in progress. Nutrient profiling has been initiated for the isolates. Some tested strains showed promising results with over 50% of total protein and 40% of total carbohydrate contents. 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 threat to the local biodiversity.

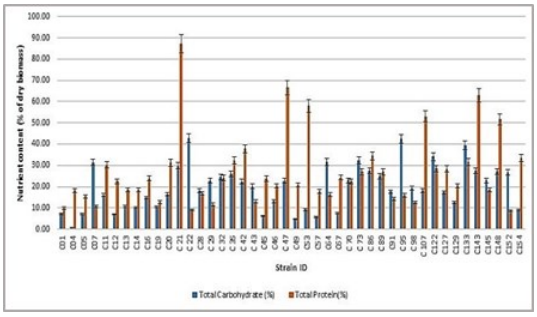

Figure 2: Nutrient contents (total carbohydrate and protein contents) of some tested strains

Development of Baseline information System for paddy soil C and other nutrients in Sri Lanka

Improving the organic matter status of soil can be considered as an alternative solution for the numerous issues that the global rice sector faces today, such as increased fertilizer demand and low yield. Hence, the current project aims at producing a digital soil map to show distribution of soil C stocks in paddy growing soils of Sri Lanka, which will be vital to nourish the national and global information deficiency on soil carbon stocks. Moreover, microorganisms play a vital role in maintaining the nutrient cycles and soil fertility. A study conducted on Microbial Biomass Carbon (MBC) content in paddy soil depicted the positive correlations between MBC and available nutrients (Zn, Cu Fe).

Further, a sub project was conducted to determine the effects of paddy crop rotation systems with the upland mycorrhizal crops, soya and onion, on the Arbuscular Mycorrhizal Fungi (AMF) sporulation, soil carbon fractions and AMF colonization in rice roots under flooded condition. Moreover, the effect of AMF sporulation and root colonization was studied for C sequestration in lowland paddy soil. Soil carbon stocks showed positive correlations with % root colonization and AMF spore number in soil. Thus, the study confirmed that C stocks in paddy soils can be improved by intercropping with AMF supporting plants like soya bean.

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

Mangroves and saltmarshes are barely holdup at earth's tropical and sub-tropical coasts. As it is undergoing slashes up to the root with land claiming for current development activities at these regions, their area of coverage is minor relative to terrestrial forests. Their contribution in sequestrating atmospheric carbon per unit area is greater than terrestrial forests.

Further data available on this aspect was limited to wet zone and dry zone ecosystems and greatness lies as the first detailed study on arid zone mangroves ecosystems specifically and will provide general interpretation over tropical region and specific interpretation on management and conversation perspectives of these ecosystems. Soil samples have been collected over the Northwest coastal area and have been analyzed for their nutrient status and carbon stocks. The data will be processed to a Geographical Information System (GIS) based map digitally visualizing the spatial heterogeneity on the above aspect.

The soil organic carbon (SOC) highly varied across the sites and the average SOC content of mangroves were around 3.5% thus distributing in high range of 1.0- 12.5%. And that of at saltmarshes were around 2.2% and within a range of 0.4-8.5%. Moreover, it was comprehended that the zonation and occurrence of vegetation was manipulated and disturbed due to human influenced activities such as land clearings for cultivation and industrial aquatic farms and induced water flow divergence. Further it was affected by natural changes over a period of time. Therefore, the further finding s of the study will be useful in need for rehabilitation of degraded mangroves and saltmarsh sites in order to optimize the carbon sequestration potential.

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Rhizobium Project

Supply of inoculants to soybean, green gram, groundnut and vegetable beans continued throughout the year. The expected increase in demand was curtailed primarily due to the drop in farming activities because of the Covid pandemic. Even the field activities of the project had to be curtailed as traveling was severely restricted. Nevertheless, the demand for vegetable bean inoculants showed an increasing trend. Submission of abstracts and preparation of full presentation (after acceptance for an oral presentation) to the National Science Foundation's National Conference on COVID-19: Impact, Mitigation, Opportunities and Building Resilience were done towards the latter part of 2020. The abstract had been published in the proceedings and the full paper is undergoing peer review prior to its publication. A special degree student from the Sabaragamuwa University conducted her research project on the isolation, purification, screening and authentication of rhizobia.

During January and February most of the time was spent for preparatory work connected with the Exhibition organized by the Ministry of Science, Technology and Research at the SLINTEC and Green University Campus premises at Homagama during the 1st week of March 2020. Designing of new posters showing the effects of rhizobial inoculation to soybean, green gram, vegetable bean and groundnut; writing and printing of instruction leaflets on the application of inoculants and setting up of demonstrations on the isolation, purification and semi-mass culturing of rhizobia, preparation of coirdust based inoculant packets etc, kept the entire staff fully occupied. The slide presentation on rhizobiology and its benefits was also revised. Unfortunately, all this work was in vain as the exhibition was cancelled after three days when the Government declared an islandwide lock down due to the outbreak of the Covid-19 pandemic. For nearly another months there was hardly any work as the NIFS laboratories were closed and only the few staff members engaged in emergency work connected with urgent research and development activities against the pandemic were allowed to report for work. Meanwhile the Government declared that crop cultivation should continue unabated and Plenty Foods PLC made an appeal for us to supply their rhizobial requirements for the approaching Yala cultivations to commence in April. Representations were made to the task force operating control measures against the pandemic and through them we obtained special permission from the IGP for two persons per day to complete the rhizobial inoculant order. As a result of all these disruptions orders for our inoculants declined significantly and the supply for the year 2020 is given in Table 1. Accordingly the income for the year also declined significantly

Table 1: Inoculant supply for 2020

Crop	Acreage
Soyabean	3633
Mung bean	150
Vegetable bean	2186 packets

Extension activities resumed only in July after the lockdown conditions were relaxed.

Vegetable bean: 50 field demonstrations were done in collaboration with the Central Province, Provincial Agriculture Department. These activities followed a briefing session held in Provincial Secretary's auditorium at the Kandy Kachcheri. The results obtained by bean farmers after these demonstrations had been impressive. At a simple felicitation event held at the Central Province Governor's Office in Kandy, the Provincial Deputy Director of Agriculture reported that the yields obtained by certain farmers were more than double of those routinely obtained with the application of chemical fertilizers. Prof. Kulasooriya and Mr. Ekanayake of the Rhizobium project were felicitated by the Governor.

Felicitation by the Governor Central Province

Mung bean: 15 farmer demonstrations were conducted in the Tissamaharama area in collaboration with Plenty foods (PVT) Ltd.

Post Covid Grant from the National Science Foundation (NSF)

A new grant award scheme by the NSF under post Covid Technology Grants for rehabilitation activities including agriculture was announced in May 2020. Technology development had to be in collaboration with a private sector partner. . A joint application was submitted together with Sara Bhumi Lanka Private Limited (a company which prepares and market bio-enriched organic fertilizer) to obtain funds for the fabrication of two bioreactors that will enhance our capacity of inoculant production. The grant was awarded in August, but the fabrication was severely delayed as the fabrication factory located in Biyagama could not operate until December as that area was under lockdown. Eventually the bioreactor was installed in early February 2021.

50L Biorector

Student training

Ms. G.G. C. Gayani Thennakoon, an honours degree student in Environmental Sciences from the Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka conducted her undergraduate research project on Morphological and Biochemical characterization of isolated Rhizobia from selected legumes plants; soybean, mung bean, cowpea, groundnut and white clover, in our project.

She underwent training in the isolation, purification, morphological, physiological and biochemical characterization of the isolates and completed the three month project by authentication of the characterized isolates. She made a presentation on this work at the annual research sessions of her university.

Recruitment of Research Assistants

Since the absorption of the Rhizobium basic research studies into the main stream research activities of the Microbial Biotechnology Division, a vacancy for a Research Assistant was advertised and Ms. Erandhi Herath was selected after a formal interview. During the same exercise another Research Assistant Ms. Raveena Rathnayake was also selected to work under the grant (MSTR/7/2/7) received from the Ministry of Science Technology and Research for the project entitled 'Restoration of soil fertility through Biofertilizers'. Bothe these RAs are due to commence their work from January 2021.

From L to R: Ms. AHMCD. Aberathna, Mr. EMHGS. Ekanayake, Prof. SA. Kulasooriya , Mr. RKGK. Kumara, Mr. AHMAK. Tennakoone

Earth, Environment & Biodiversity

The main focus of research in this cluster is discovering, evaluating, and development of the islands bountiful biotic and abiotic natural resources. Research activities are also focused on efficient use of existing resources and maintaining a cleaner environment. A team of scientists in this cluster work on monitoring and modelling of terrestrial and aquatic systems that provide scientific support for restoration and management. They conduct laboratory and field experiments on geothermal resources, toxic metal release from soil and water, their removal and modelling using low cost material. Research are also done on environmental remediation.

Another important line of research in this cluster deal with the investigation of the natural forest degradation and their restoration through natural regeneration, particularly in the dry zone of Sri Lanka. Biogeography, factors affecting biodiversity, such as Invasive Alien Plants, and conservation status of flora of Sri Lanka are also studied by the scientists attached to this cluster.

Another group of scientists in this cluster focus their research studies on understanding how ecosystems are modified by the loss of biodiversity. These studies are based on plants and animals in terrestrial and aquatic ecosystems with a special focus on the Sri Lanka–Western Ghats biodiversity hotspot. Scientists of this cluster are involved in many taxonomic and ecological research activities ranging from arthropods, such as spiders and scorpions, to primates and higher plants.

- **Earth Resources and Renewable Energy**
- **Environmental Science Research Programme**
- **Evolution, Ecology & Environmental Biology**
- **Plant & Environmental Sciences**
- **Plant Taxonomy & Conservation**
- **Primate Biology**

Prof. N. Deepal Subasinghe

Profile summary

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Research Fellow -RMIT University, Australia (2003 to 2009).

Merit Awards:

ODCSS (Overseas Develop. Corp. Schol. Scheme) - Australia; Faculty merit scholarship - Faculty of Sci., Univ. Reading, UK; ORS - Overseas Research Students Scholarship, (CVCP), UK; Australian Research Council (ARC) fellowship, RMIT University, Australia. President's Award for scientific publication.

Positions Held: President - Geological Society of Sri Lanka (2018-19). Life member -GSSL and SLAAS. Member- Board of Earth Sciences, Postgraduate Inst. of Science, Univ. Peradeniya (2017-2020), Chief Editor, JGSSL 2013-14.

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Earth Resources & Renewable Energy

With the rapidly growing demand for energy and earth resources, it is imperative to find new energy and mineral sources. Equally important is to find ways for better utilisation of the existing resources. Under the Earth Resources and Renewable Energy Project, several sub projects have been designed to develop new mineral and energy sources as well as to improve the efficiency of energy use.

The project on Geothermal resources of Sri Lanka aims to evaluate the geothermal resources to utilise them for national development, and to understand their origin. A combination of geophysical, geochemical and geological techniques were used to evaluate geothermal resources. Origin, as well as the potential of exploiting, of the Sri Lankan geothermal resources are being studied.

While, a significant number of economic mineral deposits are already known, new resources are still being discovered and some are yet to be discovered. In order to discover novel resources, a good understanding of basic principles on the origin of minerals as well as employing modern techniques, are essential. A project on Sri Lankan mineral resources and their origin is also going on. A pioneering project on radon mapping is being conducted jointly with the Atomic Energy Board, Sri Lanka to establish the baseline of the background radiation levels and to find mineral resources.

A research project on thermoelectricity is a pioneering project in Sri Lanka. Thermoelectric generators produce electricity directly from heat energy using the"*Seebeck Effect*". Thermoelectricity can increase the overall efficiency of an existing system by 'scavenging' and converting waste heat into electricity. Theoretical aspects as well as new materials are explored to increase the output of thermoelectric generators.

Geothermal Resource Mapping Project

Geothermal Energy is one of the cleanest and most reliable green energy. Clean, because geothermal energy does not emit any greenhouse gases or need to occupy a large land area to generate power. Reliable, because geothermal energy does not depend on weather conditions (rain, sun, wind etc.) or external supplies to generate power. Among all (both renewable and non-renewable) energy sources, capacity factor of geothermal plant is only second to that of a nuclear power plant. Production cost per unit of electricity and the maintenance costs are also among the lowest. However, due to lack of sufficient information and awareness, no geothermal power plant has been comissioned in Sri Lanka until now.

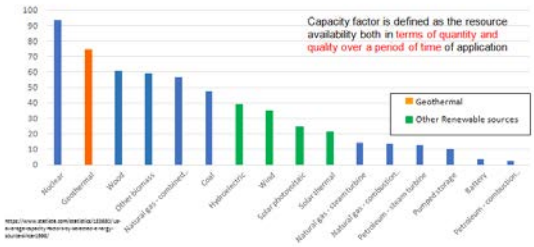


Fig.1 Capacity factors of different energy sources. Geothermal is the second highest.

Traditionally, Sri Lanka is considered to be located in a shield zone, where little or no tectonic activities are expected. Therefore, it is interesting to know the source of our geothermal resources. The NIFS, in collaboration with few other local and foreign institutes, initiated the first ever comprehensive study on Sri Lankan geothermal resources. Geological, geochemical and geophysical techniques were employed to investigate the nature of the geothermal resources. Using non-invasive, geophysical techniques such as Magneto-Telluric (MT) and Time-Domain Electromagnetic (TDEM), information on subsurface structures can be obtained without the need for drilling. Our research findings indicate that some of the thermal springs may have a potential for 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, it will also help to reduce pollution.

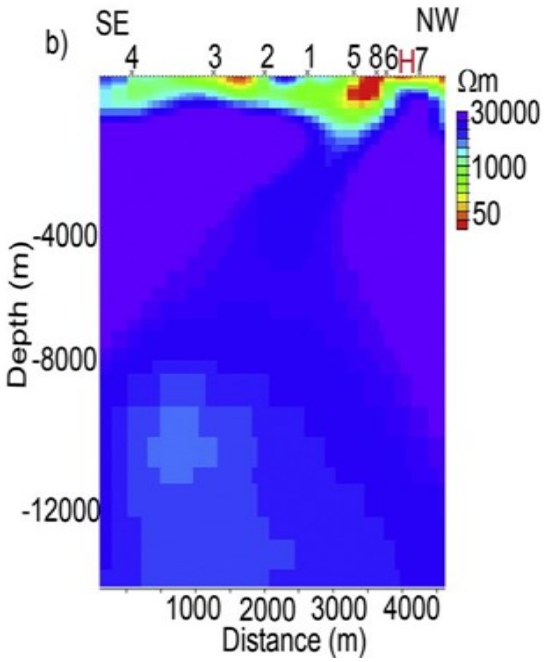


Fig.2 A 12 km deep apparent resistivity profile near Kapurella thermal stping, constructed using MT & TDEM data.

Mineralogy & Petrology of Sri Lankan Rocks

Understanding mineralogy and petrology of our rocks will help to find new mineral resources, as well as shedding more light on the origin of major lithological zones such as Highland, Vijayan and Vanni complexes in Sri Lanka.

Mineral assemblages and reactions provide clues to understand the conditions they have undergone.

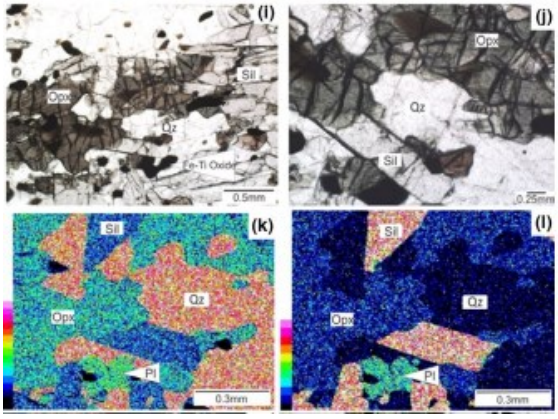
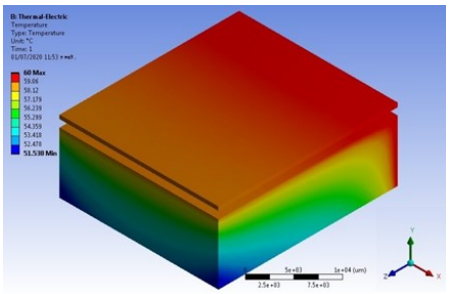


Fig.3 Photomicrographs & EDS elemental maps of Sri Lankan garnulite rocks (Dharmapriya et al 2021).

Thermoelectricity Project

Thermoelectricity (TE) is the direct generation of electrical energy from heat, using the "*Seebeck Effect*". The NIFS pioneered in introducing the thermoelectric research in Sri Lanka. TE can not only be used as a source of renewable energy, it can also be used as a co-generation technique, to improve the overall energy efficiency of existing systems. TE is already being used in automobile engines, bionic devices, camping gears, space applications, remote monitoring and many other applications to generate power.

Most of the researchers around the globe focus on developing new materials to improve efficiency and the power output. However, one of the major challenges in TE power generation is the "*Schottky barrier*", formed around the metal-semiconductor contact, reducing the overall efficiency and the power output. In addition to working on improving materials, we also work on the theoretical aspects such as heat transfer and reducing the *Schottky barrier* to improve the efficiency.



Project Personnel

Research Students :

Mr. Anjana Ratnayake (NIFS)
Ms. A.M.A.M. Abesinghe (NIFS)
Ms. G. Wijesinghe (Ministry Grant)
Ms. D.W.M. Dissanayake (NRC Grant)
Mr. K.K. Sampath Kumara (Other)
Ms. Thilini Harischandra (Lapidarist)

MPhil degrees completed

Mr. H.M.D.A.H. Bandara (Left for PhD)
Mr. N.B. Suriyaarachchi (Left for PhD)

Selected Recent Publications:

1. Dharmapriya, P.L., Malaviarachchi, S.P.K., Galli, A., Kriegsman, L.M., Osanai, Y., Sajeev, K., Su, B., Tsunogae, T., Zhang, C., Adachi, T., Dissanayake, C.B. and Subasinghe N.D. (2020). Hybrid Phase Equilibria Modelling with Conventional and Trace Element Thermobarometry to Assess the P-T Evolution of UHT Granulites: An Example from Sapphirine Granulites in the Highland Complex - Sri Lanka. ***Journal of Metamorphic Geology*, 38. 209-246..**

2. Bandara, H.M.D.A.H., Sooriyarachchi, N.B., Subasinghe, N.D. (2019). Near surface resistivity and geostructural study of the mahapelessa hot spring field, Sri Lanka. ***Jour. Geol. Soc. Sri Lanka***., 20(1), p.33-40.

From L to R: Ms. M. Abeysinghe, Mr. S. Kumara, Prof. ND. Subasinghe, Mr. RA. Ratnayake, Ms. DRTL. Harischandra

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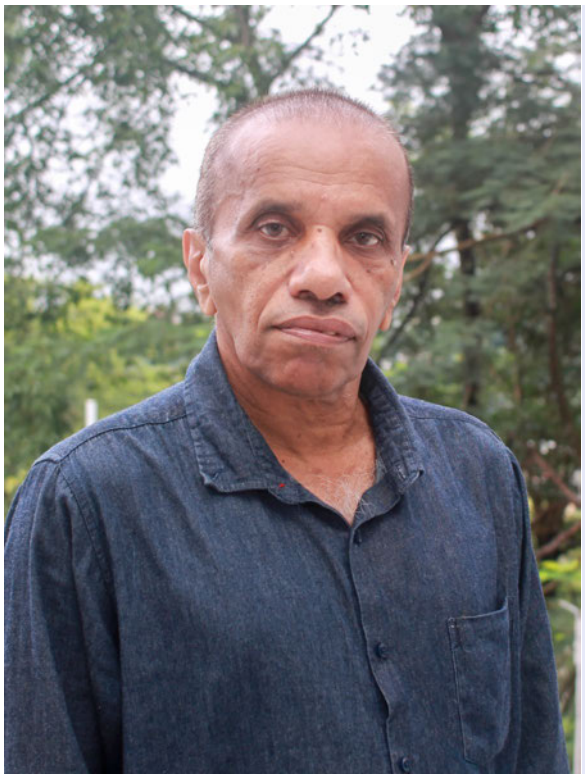

Prof. Rohan Weerasooriya

Fellow of National Academy of Sciences Sri Lanka, received PhD in geology from the University of Peradeniya (Sri Lanka). He is also currently serving as a Distinguished Professor at Hefei University of Technology. He was also DAAD Guest Professor at University of Erlangen (Germany). Fulbright Hayes Senior Scholar (University of Maryland USA), Post-Doctoral Research Associate Stanford University. He is a core member of the Joint Research and Demonstration Center for Water Technology donated by the PR China. He is serving as a visiting faculty member of many national and international universities.

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Environmental Science Research Program: Water Research

Sri Lanka is blessed with an abundance of water resources! However over 3.8 million people lack access to safe drinking water. Majority of the water related issues are dominant in the dry zone (which spans approximately two thirds of the total area of the country). NIFS researchers in collaboration with National Water Supply Drainage Board, University of Peradeniya, University of Jayawardhanapura and Rajarata University of Sri Lanka, Chinese Academy of Sciences and Hefei University of Technology and Karlsruhe Institute of Technology (Germany) are developing a sustainable drinking water facility suited to the Dry Zone where water problem is acute. The water in the Dry Zone
is characterized with high salinity. The behaviour of biologically active elements requires elucidating at high solute conditions. The solute levels in the water require mitigation to improve the water palatability. Our results show the development of water treatment facility without any external chemical addition. The performance of sand filters was also enhanced using Sri Lankan graphite-based graphite oxide as a coated layer for simultaneous removal of water turbidity and fluoride. We also
developed, using chemical speciation calculations, an integrated water quality index (IWQI) for rapid demarcation of the quality of a water body using a single value. However, experimental evidence is required for the presence of ion pairs and complexed solutes . The IWQI is in operation in a dry zone village. Pipe water classification method was refined by multi-variate cluster technique to incorporate any number of parameters. In addition, SMART sensor devices required for in situ monitoring of water quality data were developed using electrochemical methods. For *in situ* detection of mercury species a sensor was developed collaboratively with Hefei University (Prof. Xing Chen). The sensor can rapidly scan an array of toxic metal ions in water in situ. National Research Council of Sri Lanka, Natural National Research foundation of China, DAAD (Germany), One Belt and Road Countries China continue supporting our research. During year 2020, some of the research results produced by NIFS researchers and the NIFS adjunct faculty are presented.

Membrane technology

Pressure driven membrane and electrodialysis self-reversal water treatment facilities have been fabricated. The pressure-driven membrane treatment system produces 5000 L/day. The treated water is used by the Nettiyagama Primary School (Mihintale) presently. The active layers of pressure -driven membranes will be developed, enabling molecular sieving of solutes. As reported in 2019, the EDR facility scheduled to be Installed in the Faculty of Applied Sciences Rajarata University of Sri Lanka is delayed due to the current world situation.

Surface enhanced sand

Fluoride is a biologically active element and the primary source of human intake of fluoride is through water. Therefore, the development of novel methods for mitigation is timely due to its implications as a neurotoxicant. We fabricated stable, multi-layered sand-GO composites without using a binder. The sand surface progressively becomes positively charged with the increase of GO layering. Our graphite oxide coated sand has a core-shell configuration.

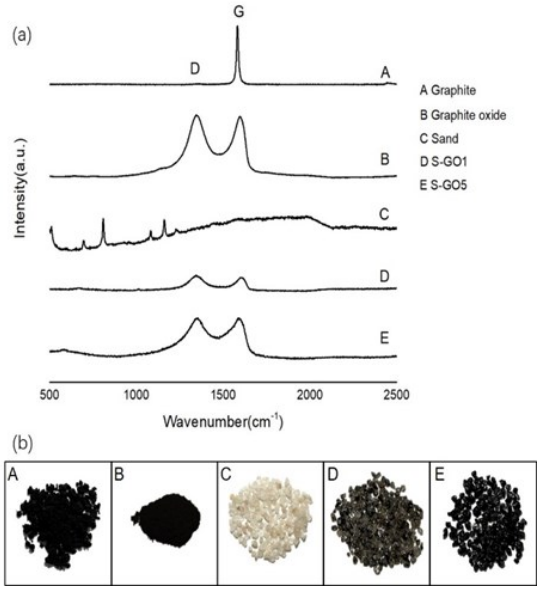


Figure (a) Raman spectrums of A: Graphite, B: Graphite oxide, C: Sand, D: S-GO1 and E: S-GO5. (b) Photo images, A: Graphite, B: Graphite oxide, C: Sand, D: S-GO1 and E: S-GO5

We examined the suitability of surface-enhanced sand for the concurrent removal of fluoride and turbidity from the water. Further research is needed to evaluate the reusability of the substrate in fluoride removal, and its potential in treating other contaminants in water.

Nitrate and hardness

Nano zero-valent iron is used to destruct a wide range of organic and inorganic contaminants in water. However, its performance is limited due to rapid aggregation and surface passivation. To minimise aggregation, we fabricated nano zero-valent iron on the reduced graphene oxide sheets using green tea derived polyphenols (hereafter rGO-nZVI-P) or borohydride ions (rGO-nZVI-B).

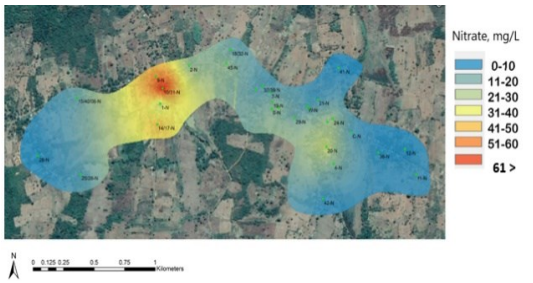


Figure. Spatial distribution of nitrate in community well waters, Nettiyagama (Sri Lanka)

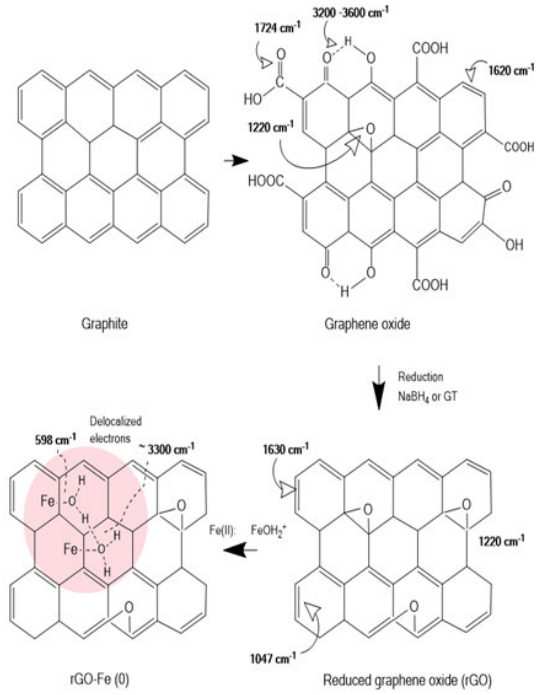


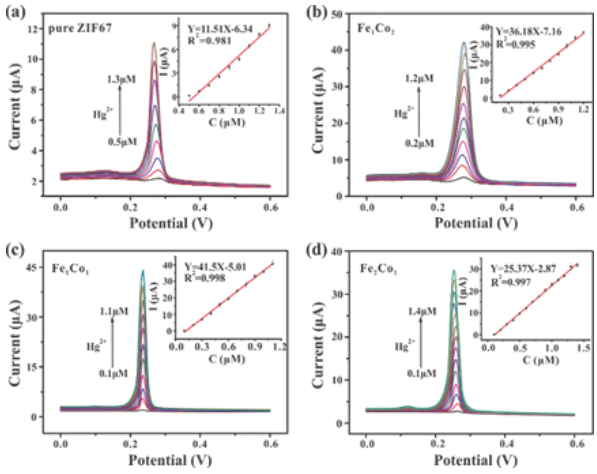
Figure. A postulated model for the association of Fe (0) with rGO. The Fe (0) adhesion on rGO believes via p-p stacking

The synthesis of Fe^0 on rGO matrix by polyphenol has resulted in nZVI with enhanced stability (rGO-nZVI-P). The nitrate reduction occurs efficiently at near-neutral pH yielding ammonia as the main product (~95 %). The incorporation of nZVI amidst rGO is believed via p-p stacking.

Further research warrants into *in situ* conversion of ammonium produced by nitrate reduction into chloramines for safe water disinfection. The rGO-nZVI-P has a promise in drinking water treatment due to its ability to reduce nitrate and TDS in natural water concurrently.

Electrochemical sensors

Sensor development research is in progress in association with the Prof. Xing CHEN Hefei University of Technology. Development of robust methods for rapid detection of heavy metal ions and associated chemical species in water is challenging.



Different mercury species are ubiquitous in the environment; they bio-amplify and undergo methylation into organo-Hg species.

We developed a new electrochemical method for rapid screening of free Hg^{2+} in water by square wave anode stripping voltammetry (SWASV) on a metal-organic framework (MOF) platform using ZIF-67 as starting substrate.

The new chemically modified sensing electrode does not interfere with Cd^{2+}, Pb^{2+}, Cu^{2+} and Zn^{2+}. The spike recovery of 0.3 to 1.00 µM Hg^{2+} with ZIF -67/ Fe_1Co_1 modified GCE was always above 99.0%. The chemically modified sensor with ZIF-67/ $Fe_1C\ o_1$ holds a promise in monitoring Hg^{2+} at trace concentrations.

Dissolved organic matter and human health

Professor Wei, Adjunct Faculty, NIFS, Director, RCEES, Chinese Academy of Sciences and his group are engaged in elucidating health implications resulting from dissolved organic matter in water. The research has shown groundwater plays a potent etiological role in the peculiar distribution of chronic kidney disease of unknown etiology. The organic sulfonate formed in association with soil humic acid (Sri Lanka) and hard water is postulated as a uremic toxicant.

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Ms. P.M.C.J. Bandara

Jayani Bandara is currently a M. Phil Research Assistant with the Environmental Sciences Research Program at National Institute of Fundamental Studies (NIFS). She received her B.Sc. special degree in Environmental Science from the University of Peradeniya in 2018, and joined NIFS in 2020. Her research focuses on the development of a unit process using sand composites for treatment of drinking water. She has research experience related to nano zero Valent Iron in reduction of nitrate in the drinking water.

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Ms. Upeksha Halpegama

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Mr. Wu Zhiguo

Wu Zhiguo Optoelectronics Co., LTD, Wuhan is a M. Phil candidate from the NIFS and PGIS University of Peradeniya who is developing intelligent controller systems for remote maintenance and operation of water treatment plant in a Sri Lankan village under the supervision of Dr. Chamara Jayasundara (University of Peradeniya), Professor Xing CHEN (Hefei University of Technology) and Professor Rohan Weerasooriya (NIFS and Hefei University).

Dr. Lakmal Jayarathna

BSc (Sp) Chemistry 2006, PhD 2013 (UOP). Research Fellow (Environmental Science Research program), NIFS, Sri Lanka, Research Scientist, Material Technology Section, Industrial Technology Institute (2013-2017).

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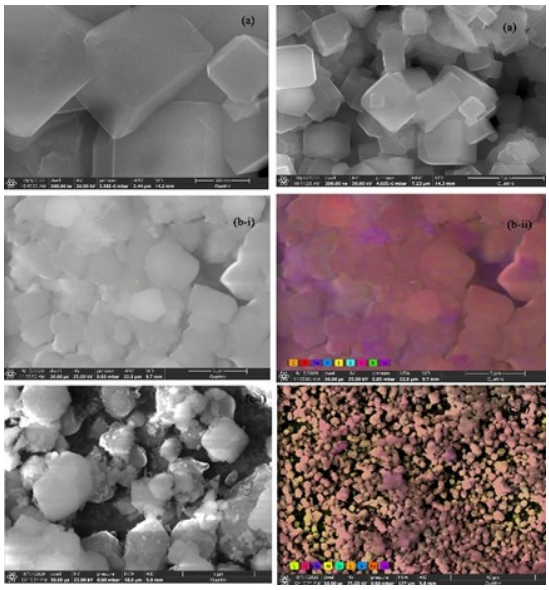
Environmental Science Research Program: Materials Development and Fabrication

Materials development and fabrication program under the Environmental Science research project has to be considered as an area of fundamental and applied science. Materials present in the environment play a vital role to control, mitigate and remediation of pollutants. However, these naturally presence materials cannot remediate the environment anymore. Due to the increase of the anthropogenic activities. Therefore, new materials with higher efficiency must be developed. 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 to the national development. Nano and composite materials show higher efficiency in the remediation of pollutant in the environment.

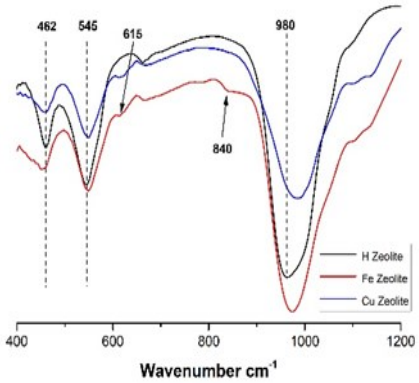
Synthesis, characterization and determination of the catalytic activity of Fe and Cu modified zeolite catalysts from local kaolin clay.

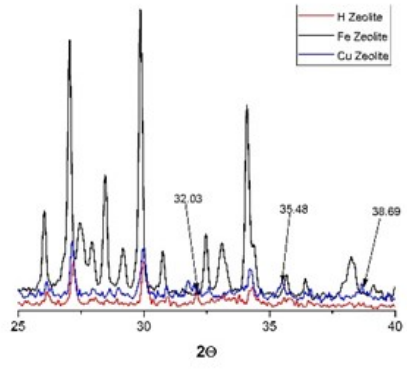
Zeolite is a crystalline aluminosilicate framework which comprises of a tetrahedral arrangement of Si^{4+} and Al^{3+} that are surrounded by O^{2-}. Zeolites are used in various applications in solving environmental, scientific, industrial and day to day problems due to their flexibility and adaptability. Some of the major applications of zeolites are purification of water, the formation of sludge, medicinal uses and catalysis. In my study, zeolite was modified with $FeSO_4$ and $CuSO_4$ using the solid-state ion exchange method to produce modified Fe-zeolite and Cu-zeolite catalysts respectively. The modified catalysts, were characterized using FTIR, XRD and Particle size analysis. Catalytic isomerization of glucose to levulinic acid and benzylation of toluene and benzyl alcohol reaction was used to determine the catalytic activity of the modified Fe-zeolite and Cu-zeolite catalysts. Cu-zeolite catalyst is more selective towards the formation of diphenylmethane than the Fe-zeolite catalyst which synthesizes the by product dibenzyl ether.



Hydrothermal synthesis, characterization and determination of catalytic activity of nano-mordenite

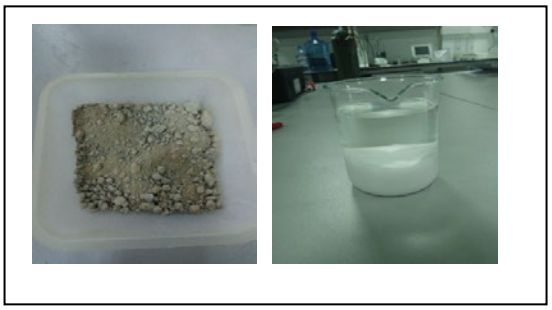
Mordenite is one of the most highly siliceous zeolites which have an ideal composition of $Na_8Al_8Si_{40}O_{96}.24H_2O$. Mordenite has been used mainly as a catalyst for many industrially important reactions such as alkylation, hydrocracking, hydroisomerization, dewaxing, reforming, and cracking. Mordenite has also been used in the absorptive separation of gas or liquid mixtures, where it is used as a molecular sieve. In this work, mordenite was synthesized by a hydrothermal synthesis method. Hydrothermal synthesis is commonly used in the synthesis of aluminosilicate zeolites due to its advantages over other methods such as effective solvation ability of water, increased solubility of reactants and increased nucleation. The catalytic performance of the synthesized and modified modernities was investigated by performing a catalytic liquid phase alkylation reaction of benzene with benzyl alcohol which gives Diphenylmethane (DPM) and Dibenzyl ether (DBE) as main products. Reaction products were analyzed using LC-MS and FTIR. According to the results obtained, H-MOR showed higher selectivity to Diphenylmethane while Fe-MOR showed higher selectivity to Dibenzyl ether. However, Zn-MOR showed low catalytic activity for the benzylation reaction





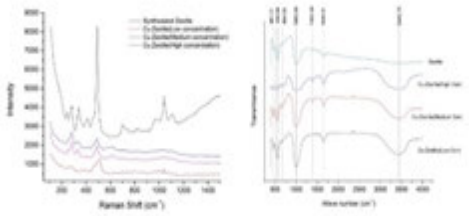
Purification of locally available Kaolin

Kaolin is a finely granulated, white or pale yellow colour mineral which contains a mixture of hydrous silicates and aluminium and silicon hydroxides as the main component. Due to its special properties such as fine particle size, natural whiteness and chemical stability, it's widely used in many industries. But kaolin cannot be directly used for these industries because it contains impurities such as organic impurities, iron oxides (mainly Fe_2O_3), titanium impurities (TiO_2) and anions and cations as well. The presence of iron oxide in kaolin has a deleterious effect on the colour of the clay, which declines in brightness with increasing iron content. The purpose of this project is to remove impurities present in kaolin to obtain purified kaolin. In this project a modified method was developed for purification of kaolin clay. This purified kaolin then can be used for several industries and to synthesize some other chemical compounds (ex:- zeolite). This will be a valuable addition to locally available kaolin and helps to improve the country's economy.



Development of zeolite based selective catalyst

Zeolites are crystalline, microporous aluminosilicates with a 3-dimensional framework consisting of oxygen-sharing TO_4 tetrahedra, where T stands usually for Si and/or Al. Their framework structure contains interconnected voids that are filled with adsorbed molecules or cations. The tetrahedra are linked together to form cages connected by pore openings of defined sizes and shapes. zeolite modification plays an important role in controlling acid activity and the shape selectivity of a specific structure of a zeolite. Several methods are used for the modification of zeolite structure. Among the most common methods are ion exchange and acid leaching. Microwave heating is also a method being used in industries and by researchers for modifications. The development of zeolite-based selective catalytic reduction (SCR) system for the reduction/removal of emission of harmful gasses, this is a major goal of this research project.



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

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

Air pollution modelling is used to estimate population and individual level exposures which are important in health risk assessments. Research projects at the “Air Pollution Modelling and Health Risk Assessment” group are aimed at modelling air pollution in Sri Lankan urban and rural areas, estimating health risk associated with air pollution and evaluating performance of air pollution control methods. Hence, the information generated can be utilized to identify vulnerable groups, 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.

$PM_{2.5}$ air pollution monitoring network using smart sensors:

We have set up a particulate matter <2.5 µm in diameter ($PM_{2.5}$) air pollution monitoring network in the Kandy Municipal Council. In Kandy there is only one standard air pollution monitoring station that is operated by the Central Environmental Authority (CEA). This single monitoring station does not represent actual levels that the residents are exposed to. Recent technological advances in the development of smart sensors to monitor air pollution has opened an opportunity to establish low cost air pollution monitoring networks. These sensors are able to measure pollutants at high spatial and temporal resolutions, which is a notable advantage in assessment of exposure to environmental contaminants. In Kandy,10 sensors were located in representative locations. In addition to Kandy we have deployed two sensors in Colombo to measure air pollution in both urban and semi-urban areas. The collated data will be used to develop a land use regression model to predict air pollution in the Kandy municipal area.

Air pollution in Kandy and Colombo during COVID 19 lockdown:

The COVID-19 pandemic has led to the complete lockdown of many cities worldwide. Lockdowns have significantly changed human behavior. We investigated the variability and trends of $PM_{2.5}$ and carbon monoxide (CO) before and during the COVID-19 lockdown period in Kandy and Colombo. The highest average reductions of $PM_{2.5}$ and CO were observed in Colombo's "Urban Background" area (52.4% and 46.7%, respectively). In Kandy, "Urban Background" site had a higher reduction of PM2.5 and CO (30.2% and 41.2%, respectively), compared to "Primary Residential" (10% and 9%, respectively). The daily averages of the pollutants' concentrations were higher before the lockdown period compared to during.

Overall, a significant downward trend was observed of air pollutants over the entire study period. In Sri Lanka, the COVID-19 lockdown improved air quality significantly in urban areas (FIG1).

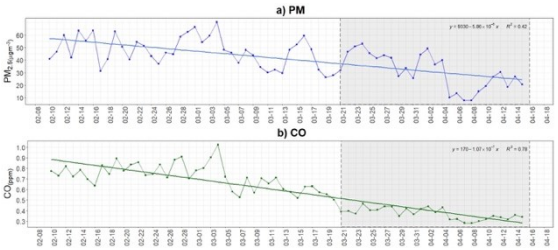

FIG1: Daily variation and trend of $PM_{2.5}$ and CO before and during COVID-19 lockdown period in Colombo.

Ambient $PM_{2.5}$ exposure and respiratory disease hospitalization in Kandy, Sri Lanka: PM2.5 air pollution is high in the South Asian region. Evidence of associations between exposure to Ambient Air Pollution (AAP) and health outcomes are sparse in this region due to limited exposure- and/or lack of quality health-data. We investigated the effects of ambient $PM_{2.5}$ on respiratory diseases (RD) hospitalization in Kandy, Sri Lanka during the year 2019. Two distinct periods were identified during 19-03-01 and 19-05-31, higher daily average $PM_{2.5}$ levels (48.8µg/m3±14.9) were observed compared to 19-08-01 and 19-10-31 (25.3µg/m3±5.4).

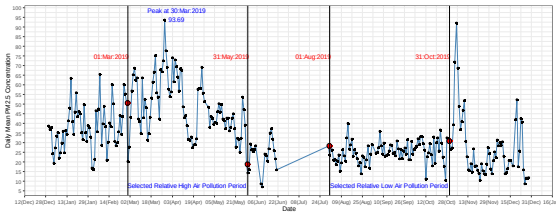

FIG2: Daily average $PM_{2.5}$ air pollution in Kandy in 2019

Compared to the low AAP reference period, high AAP period was associated with increased hospital admissions for RD, Rate Ratio (RR) 1.21(95%CI 1.15–1.28). Risk of RD hospital admissions were higher among elders (>65 years) RR 1.31(95%CI 1.20–1.43) in contrast to <65-year old's, RR 1.16 (95%CI 1.09–1.24). Compared to low AAP period high AAP period was associated with increased risk of Chronic Obstructive Pulmonary Disease (RR 1.35 (95%CI 1.20–1.51) and pneumonia (RR 1.58 (95%CI 1.13-2.20)) hospital admissions.

Research Student: Mr. Mahesh Senarathna.

Key Publications:

1. Clark DP, Son DB, **Bowatte G**, Senaratna CV, Lodge C, Perret JL, Hamilton GS, Dharmage S. The association between traffic-related air pollution and obstructive sleep apnea: A systematic review.
   Sleep Medicine Reviews. 2020 Jul 11:101360.

2. Lodge CJ, Lowe AJ, Milanzi E, **Bowatte G**, Abramson MJ, Tsimiklis H, Axelrad C, Robertson B, Darling AE, Svanes C, Wjst M. Human milk oligosaccharide profiles and allergic disease up to 18 years.
   Journal of Allergy and Clinical Immunology. 2020 Jul 7.

3. Bui DS, Perret JL, Walters EH, Abramson MJ, Burgess JA, Bui MQ, **Bowatte G**, Lowe AJ, Russell MA, Alif SM, Thompson BR. Lifetime Risk Factors for Pre-and Post-Bronchodilator Lung Function Decline. A Population-based Study.
   Annals of the American Thoracic Society. 2020 Mar;17(3):302-12.

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Evolution, 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 Molecular morphological evidance

Testing fundamental evolutionary hypothesis on clade relationships and trait diversification come up with many aspects of evolutionary biology. In this new project we aim to study the evolution and diversification of the Theridiidae genera *Argyrodes*, *Chikunia*, *Cephalobares, Coleosoma*, *Meotipa, Neospintharus and Rhomphaea*. Further, we aim to revise taxonomy of these genera.

Theridiidae is one of the largest spider families consisting of 2300 described species placed in 109 genera. Sri Lanka is known to harbor numerous endemic spider lineages and still a large number of endemic species of spiders remains undiscovered and unrecorded. Scientific documentation on Sri Lankan cobweb spiders began almost a century ago. However, to date, only 31 theridiid species have been recorded.

Perhaps the most beautiful Theridiidae genus is *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* 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.

Our molecular analyses support the monophylly of *Rhomphaea* and *Neospintharus* where *Rhomphaea* is sister to *Neospintharus*. We also discovered 4 new species of *Rhomphaea*, 2 new species of *Neospintharus*. We also rediscovered 1 species of *Cephalobares*, 2 species of *Colesosoma* and 5 species of *Argyrodes* (1 species might be new to science), during the review period.

Molecular Phylogeny and Systematics of three jumping spider Tribes (Araneae: Salticidae) of 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 UpToDate taxonomic evaluation of the jumping spider genera *Ballus*, *Colaxes, Marengo* and *Flacillula* and place them in the salticid tree of life, taxonomic descriptions of *Ballus*, *Colaxes*, *Marengo* and 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* and *Portia*. Molecular phylogeny of *Ballus*, *Marengo* and *Colaxes* was based on a combined molecular data set of H3+CO1+28S gene fragments. The phylogenetic analyses were conducted separately for *Ballus* + *Marengo* + *Colaxes* and *Flacillula*.

According to maximum likelihood 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 together in 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* and *Telamonia* (Araneae: Salticidae) of Sri Lanka.

The objectives of this project are to revise the taxonomy of species of jumping spiders of the genera *Carrhotus*, *Epidelaxia* and *Telamonia* in Sri Lanka and to study the phylogenetic position of these selected jumping spider genera within a phylogeny of the family and outgroups.

Molecular phylogeny of *Epidelaxia* was based on a combined molecular data set of *CO1* + *18S* + *28S* + *H3* target gene fragments. Through this study we were able to conclude that *Epidelaxia* species form two clusters in maximum likelihood tree: *E. albostellata* that inhabits central highland cloud forests of Sri Lanka and *E. albocruciata* lowland forest species. These two clusters appear sister species to *Epidelaxia* sp. C and *Epidelaxia* sp. G. Further, maximum likelihood analysis shows that *Epidelaxia* is closely related to the genera *Idastrandia*, *Nannenus* and *Langerra*. Molecular placement of genus *Epidelaxia* concludes that it belongs to the tribe *Nannenini*.

Another interesting outcome of the study is the discovery of a new genus which is closely related to *Epidelaxia* and named provisionally pending formal description, as genus X. genus sp. A and Genus X sp. B. found to be sister to each other and to the *Epidelaxia* clade. This study adds 04 new species and demonstrates the evolutionary history of *Epidelaxia* and validates the phylogenetic placement of both genera in the tribe Nannenini.

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.

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Key Publications:

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.***

Ranasinghe, U.G.S.L. and Benjamin, S.P. 2018. Three new species of *Aprusia* (Araneae: Oonopidae) from Sri Lanka with a phylogenetic analysis of the genus.
Journal of Natural History 52: 713-738.

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.

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.

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Plant & Environmental Sciences

The focus of the Environmental Remediation project is on addressing environmental issues such as controlling environmental pollution, recovering and reusing of waste material, and carbon dioxide reduction. We utilize natural and synthetic materials such as plant-based systems, bio-polymer layer silicates and Metal Organic Frameworks (MOFs) for remediation of textile dyes, heavy metals and nitrates and phosphates. Living plants are used to absorb phosphates from contaminated environments such as farm water runoff to be recycled as fertilizer for crops. Our research group has also developed polymer composites with commonly available minerals such as kaolin and feldspar in combination with biomaterials such as chitosan and alginate. These synthetic materials are used to remove phosphate, textile dyes, and heavy metals from water. Use of biochar for pollutant removal is another research area; sewage sludge collected from municipal waste was converted to biochar to remove textile dyes.

The Plant Tissue Culture laboratory is developing *in vitro* protocols to mass propagate dry forest tree species to provide planting materials for reforestation. While inducing *in vitro* rooting is difficult in tree species, we have initiated roots in Mee (*Madhuca longifolia*). Additionally, experiments were conducted to break the dormancy of forest tree seeds that are difficult to propagate under natural conditions. Another herbaceous medicinal plant, *Stevia rebaudiana*, was micro propagated in the laboratory to provide dry mass to replace sugar in confectionery and beverage industries. The protocol was developed with low-cost natural growth enhancer as an alternative to replace the expensive artificial growth media.
We also provide training in Plant Tissue Culture for small scale entrepreneurs.

Environmental remediation

Discharge of industrial effluents, without proper treatment, from industries such as batik, textile dyeing, metal plating, and leather tanning contaminates the environment with organic dyes and heavy metals. These eventually create problems for the environment and human wellbeing. On most occasions, small and medium-size industries are unable to invest in high-tech expensive wastewater treatment systems and thus are forced to discharge their effluents to nearby waterways without proper treatment. A cost-effective simple decontamination method (i.e., end pipe treatment system) is therefore needed for use in these industries. Further, it is necessary to decontaminate the contaminated water bodies to provide a safe environment for all living beings. As the Environmental remediation project of the Plant and Environmental Science research group, we have developed and synthesized adsorbent filter materials and identified plant species to use in water bodies as phytoremediators.

The project has utilized phytoremediation techniques and adsorption processes to recover phosphates and nitrates from the aquatic environment. Phosphate absorbed aquatic plants were subsequently used as fertilizers.

During the year 2020, Metal Organic Frameworks (MOFs) were synthesized to remediate nitrates 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 heavy metals and textile dyes. We used a green synthesis method (microwave-assisted hydrothermal method and NaOH and H_2O) to synthesize the Metal Organic Frameworks MIL 53(Fe) illustrated in Fig. 1.

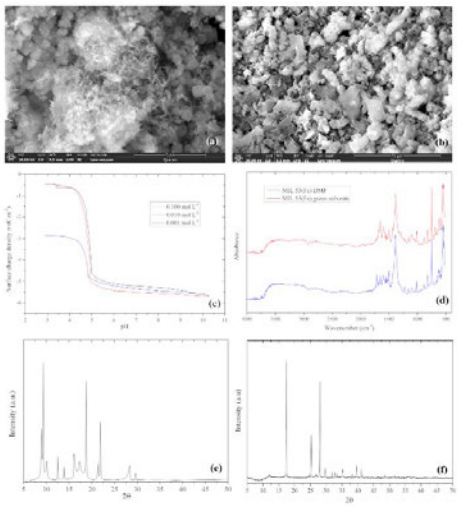

Figure 1: SEM images of MIL 53(Fe) (a) synthesized using DMF (b) synthesized using NaOH+H_2O, (c) surface charge density variation with pH, (d) FT -IR spectra of MIL 53(Fe), and the PXRD analysis of MIL 53(Fe) (e) synthesized using DMF (f) synthesized using NaOH+H_2O.

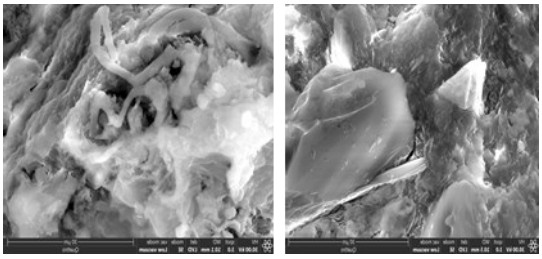

Figure 2: SEM images of (a) raw sludge and (b) biochar

Polymer layer silicate composites prepared from, alginate and kaolin, chitosan and kaolin, and alginate and feldspar showed good adsorption capacities for Cr(III), textile dye and phosphate removal. The biochar prepared by pyrolyzing sewage sludge was used to remove textile dyes. Preliminary studies showed removal of over 90% in the pH range 5-9 for methylene blue dye. The biochar adsorbent successfully removed both direct blue and red pigment dyes effectively.

Plant Tissue culture

The project focuses on the restoration of dry forests that is extensively degraded in Sri Lanka. Mass production of micropropagated planting materials should compensate for the lack of seedlings for restoration. Typically, these trees are propagated through seeds, but is limited due to seed dormancy, seasonal variations, slow growth rate and unavailabililty in the required quantities. In Sri Lanka, dry zone forest species receive less attention compared to rain forests. Hence, the project focused on micropropagating native tree species such as “Mee” (*Madhuca longifolia*) and “Palu” (*Manilkara hexandra*) which have higher economic value as timber due to their strength and durability.

Figure 1: a. “Mee” (*Madhuca longifolia*) plants
b. “Palu” (*Manilkara hexandra*) plants

Woody plants are inherently difficult to germinate due to their recalcitrant nature, a higher load of contaminants internally or externally present, phenolic or toxic exudates and slow growth rate. *In vitro* and *ex vitro* germination, direct and indirect organogenesis and embryogenesis have contributed to growth of different plant parts of the plant species. Different Plant Growth regulators (PGR) including cytokinin and auxins were integrated in culture media to induce shooting, multiplication and rooting to regenerate a whole plantlet.

Additionally, there are plant inherent reasons that reduce natural germination and different treatments were experimented to release seed dormancy. We attempted to promote germination by pre-chilling treatments with gibberellic acid, potassium nitrate and changing light conditions.

Figure 3: Seeds for *in vitro* propagation
(a – "Mee" seeds, b – "Palu" seeds)

Another protocol was developed to micro propagate Stevia, a natural sweetener that produces zero-calorie diterpene glycosides in its leaves. The plant is known to have 300-400 times sweetness than sucrose. Coconut water was used as a natural growth enhancer to replace artificial growth media while incorporating different cytokinin and auxins to increase the vegetative mass. Results showed that Stevia can be mass propagated economically with a little amount of nutrients in a short period of time. The protocol would be highly beneficial for large scale stevia growers and food industries to replace sugar in their products for consumption by people affected by diabetes mellitus.

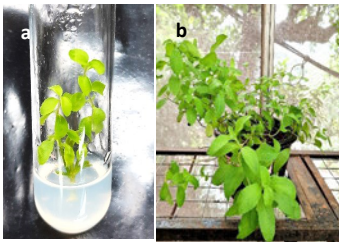

Figure 4: a. *In vitro* grown stevia, b.
b. Acclimatized stevia plant

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Plant Taxonomy and Conservation

The main research areas of the Plant Taxonomy and Conservation project are: a) Taxonomic and Biogeographical Studies of flora of Sri Lanka, b) Restoration Ecology, c) Sustainable Use of Sri Lankan Plants, d) Factors affecting the conservation of flora of Sri Lanka including Invasive Alien Species, and e) Preparation of the National Red List for flora.

Due to various reasons the conservation of our floral wealth has become an important national priority. The Sri Lankan government plans to increase the natural forest cover from the current 29.7% up to 32%. NIFS-Sam Popham Arboretum (NIFS-SPA) is considered as the best site in Sri Lanka for a restored forest using 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 this project is to develop this important arboretum. The woody vegetation in that arboretum was mapped on a GIS map for one third of the arboretum and research on regeneration is continuing. The interpretative signage including maps and informative panels on both flora and fauna, was established within the arboretum .

Research activities on natural products from medicinal and invasive plants were carried out in collaboration with Universities of Peradeniya and Sri Jayawardenapura. Work related to the compilation of National Red list for flora was continued with the assistance of expert teams conducting meetings at the National Herbarium.

Floristic Survey of IFS-Popham Arboretum, Dambulla

Ten experiment plots (10 x 10 m) were established in the NIFS- Popham Arboretum and Kaludiyapokuna forest reserve to compare natural regeneration and ANR. Plots were selected randomly and the girth of woody individuals above 10 cm trees and species names were recorded in each plot.

Fig : taking measurements of selected plants

Diversity indices were calculated for comparison of natural forest and ANR restored land. Three soil samples were collected from each plot and mixed to make a composite sample. Fifteen samples from fifty year old restored land within the arboretum, 12 samples from 20 year old restored land (woodland) and 9 samples from un- control blocks were analysed. These samples were used to investigate soil characteristics. (soil pH, water content, available C, N, P, K, Mg, Ca, Fe, Zn, Cu, bulk density and conductivity) that change trough ANR succession.

Fig : NIFS Arboretum

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

The main objectives of this study is to, understand discrepancies in present taxonomy and nomenclature through morphological characterization; understand genetic diversity and phylogenetic relationships of *Syzygium* species in Sri Lanka through species delimitation studies using appropriate barcoding markers, understand climate change impact through ecological niche modelling on selected endemic species Plant materials were collected for voucher specimens and DNA extractions while flowers and fruits were collected in FAA solution.

Fig : preparing specimens

For a single species, at least three individuals from a single locality were collected while collections were made at least at three locations for widely distributed species. All the prepared voucher specimens were deposited at PDA. A morphological character table with 89 characters was developed for studies. Seventy two DNA sequences of 29 species generated using nuclear ITS were aligned with last updated phylogeny of the genus including total of 154 taxa and a maximum parsimony analysis was performed.

Based on morphological studies it was revealed that species diversity in Sri Lanka will be more than described (c. 35 taxa) including significant intra-specific diversity observed in number of species i.e. c. 8-10. According to preliminary analysis of DNA sequence data, Sri Lankan *Syzygium* species are distributed mainly in the sub genus *Syzygium,* also in sub genera *Perikion* and Sequestratum. Another distinct clade was found in the present analysis with some species from mainland India, which is not recognized in the last updated phylogeny of the genus. Intra species diversity recognized in morphological studies was also reflected in the analysis.

Generating sequences for ETS nuclear marker to conduct combined analysis on ITS+ETS for delimitation studies with c. 250 samples is underway and acquiring sequences for chloroplast matK, ndhF, rps16 is already planned on distinct Sri Lankan taxa, c. 35 to align with global phylogeny.

Taxonomic studies of *Strobilanthes* species in Sri Lanka

Extensive plant explorations were conducted across the entire distribution range of the genus *Strobilanthes* in Sri Lanka covering 21 administrative districts from September 2005 to July 2020. The species of genus *Strobilanthes* grow from 100 m up to 2800 m, in a very wide range of different habitats such as, dense aggregations along steep rocky slopes, along margins of grasslands, dense aggregations along slopes at lower altitudes, in plains, thick rainforest undergrowth, shaded places in ravines, open rocky cliffs, on the exposed rocks, along stream banks, evergreen forest margins, primary forests, scrambling shrub growing through other plants, moist rocks along streams. *S. gardneriana*, a critically endangered possibly extinct species, could be found from Hantana at 1330 m elevation in 2020 after 1927 and another critically endangered species, *S. rhytisperma* was also found from Gendagala in 2019. Species distributions are wider with increasing altitude. Some species were not found in their type locality, such as *S. laxa*, *S. stenodon* but they were found at other locations.

Fig : *Strobilanthes* sp.

An extended distributional record for many species of *Strobilanthes* could be found. The principle threats in the study area are urbanization, cultivation, tourism activities, fire, overgrazing, pollution, road and dam constructions. In the near future, plant diversity may decline and threatened species may disappear in the area if necessary conservation measures are not taken.

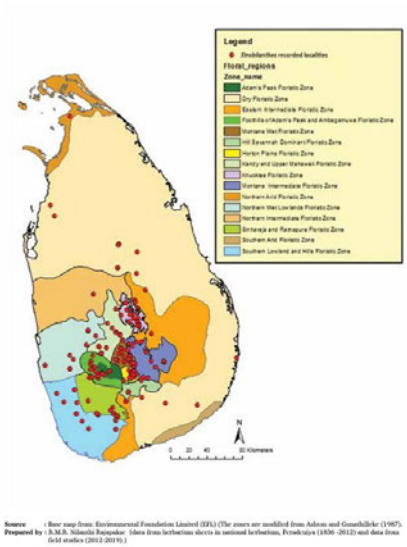

Fig : *Distribution of floristic Zones in Sri Lanka*

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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 35 such documentaries have been produced, more are planned in 2021. 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.

A 24-year study of primates at Polonnaruwa reveals that electrocutions of arboreal wildlife can be prevented.

The expansion of human activity into wilderness areas brings in its wake ever increasing conflict between wildlife and humans, one aspect of which includes the electrocution of animals on power lines. Electrocutions have been documented for Asian elephants, raptors worldwide as well as primates in Africa, Latin America, and Asia.

At our study site at Polonnaruwa, the threat is posed by uninsulated wires mounted on single posts that are commonly found in rural and urban primate habitats where monkeys are at risk of electric shock by climbing up the posts. Inquisitive monkeys may also bite into insulated wires or contact uninsulated electric wires and installations from trees. Electric shock is an important cause of death and serious permanent injury. The objective of this research was to test the efficacy of specially designed shields that were mounted on electric post and prevented monkeys' access to the deadly wires. Such shields were mounted on electric posts in 1987 along a 1.5 km stretch of road that cut through the home ranges of three groups of toque macaques at the Polonnaruwa Nature Sanctuary

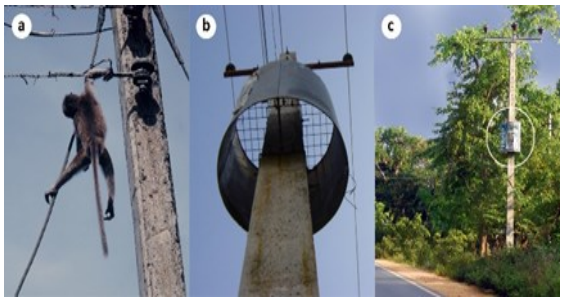

Fig. 1. Toque macaques were at risk of electrocution (a) when climbing electrical posts, but specially designed shields (b) mounted on electrical posts (c) prevented their access to the electrical wires and safeguarded them from electrocution

Our long-term research records (1975-1999) of the demography and ecology of toque macaques were analyzed retrospectively in 2020 to test the efficacy of these shields. The observation of one live known monkey for one month was defined as a monkey-month. The table show a comparison of the number of monkeys electrocuted in the 12-year periods before (1975-1987) and after (1988-1999) the installation of the anti-electrocution shields in areas protected (A) and not (B) by shields.

	Before shield installation N	After shield installation N	Fisher Exact Test P
Monkey-months observed	9,538	18,684	
A. Protected area			
Electrocutions observed	18	0	
Electrocutions expected	6	12	< 0.001
B. Unprotected areas			
Electrocutions observed	4	9	
Electrocutions expected	4	9	= 1.000*

*Not significant

Expected numbers of electrocutions were adjusted by the different numbers of monkey-months that animals were exposed to the wires in the two periods. There were no electric shock casualties after installation of the shields (A), but where these shields were absent (B) the number of electrocutions was proportional to that of monkeys at risk.

The shields on electric posts significantly reduced electrocution casualties and they can be adapted to several different species and habitat countries where similar risks prevail.

In addition to electric posts, electric wires posed a threat to wildlife when wires were accessible from tree branches. By encapsuling electric wires in sturdy PVC water pipes at known places where monkeys and other arboreal animals were at risk, electrocution casualties were reduced.

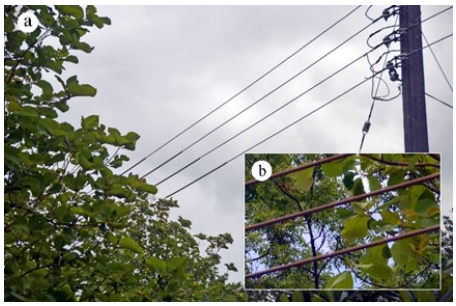

Fig. 2. Short segments of uninsulated electric cables that coursed near tree branches (a) were encapsulated in PVC water pipes (b) as a supplementary means to prevent monkeys and other arboreal mammals from suffering electrocution at sites where the trimming of tree branches was irregular.

Demography, behavior and range use 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 is the basis for population ecology studies, comparisons among species and social groups within each species. Field observations and census were carried out in 2020 as a continuation of earlier work. The field work is the partial responsibility of project conservation officers Mr. Chameera Pathirathne and Sunil Rathnayake. The population trends and activities of the nocturnal loris, *Loris lydekkarianus*, too were being monitored with nighttime observation.

A common occurrence: A toque macaque grooms the fur of a gray langur that never reciprocates - challenging an evolutionary explanation for this seemingly one-way altruistic act between species.

Left to right: Chameera Pathirathne, Sunil Rathnayake, certified naturalists (Open University) and primate experts.

New initiative (in preparation): Dental eruption and wear in 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.

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.

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

Publications, 2020

Dittus WPJ (2020). Shields on electric posts prevent primate deaths: a case study at Polonnaruwa, Sri Lanka. *Folia Primatologica* 91: 643-653. DOI: 10.1159/000510176

Documentaries

International films firsts broadcasts in 2020.

"Animal Babies: First Year in the Life of a Toque Macaque." *BBC Natural World*.

"Mamas of toque macaques" *Plimsoll Productions, UK. Animal Channel, Discovery*.

"One male and his harem of Sri Lankan toque macaques face survival challenges" *NHK, Japan Natural History Channel.*

Molecular Biology & Biotechnology

Molecular biology is studying the chemical structures and processes of biological phenomena that involve the basic units of life, the molecules while in biotechnology biological processes, organisms, or systems are used to manufacture products to improve the quality of human life. The cluster consists of three projects Molecular Microbiology & Human Diseases, Medical Entomology and Plant Stress Biology & Molecular Genetics.

Molecular Microbiology & Human Diseases project particularly seeks to understand the distribution of microbial communities in different environments; air, water and soil as well as within the human lung and the role of these microbes in disease pathogenesis and progression.

The aim of Plant Stress Biology & Molecular Genetics project is to gain a comprehensive understanding of the mechanisms of climate stress tolerance in plants in order to make informed decisions as to what is required to improve the stress tolerance levels of crops. Current focuses of the project include improvement of rice yield gap by manipulating photosynthesis and bio fortification of rice with Zn and Fe.

- Molecular Microbiology & Human Diseases
- Plant Stress Biology and Molecular Genetics

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Molecular Microbiology & Human Diseases

The research interests of MM&HD project revolve around microbial ecology in different environments and the effect of microorganisms on human diseases. The environments we focus are air, water and soil. We pay attention to both communicable (CD) and non- communicable diseases (NCDs) that affect humans globally as well as nationally.

The major health issue which has been gripping Sri Lanka for last three decades, chronic kidney disease of unknown aetiology (CKDu) and pulmonary diseases are the two major areas being studied. In pulmonary diseases, drug-resistance of *Mycobacterium tuberculosis* is being extensively investigated. We have on-going collaborative projects to genetically characterize drug resistant *Mycobacterium tuberculosis* isolates from Sri Lankan and Pakistani TB 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 uptake mechanism of these risk factors in plants. Thermophilic microorganisms in hot springs of Sri Lanka are an understudied area and the utility of the extremophiles in 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 Wickremasinghe & we are awaiting permission to conduct Balloon flights over Sri Lanka for air sampling. With a different aspect, we conduct an epidemiological study on Asbestos industry workers in Sri Lanka with the aim to determine the occupational health related issues due to chemical and physical properties of this roofing material when manufacturing. To achieve our goals, we utilize a variety of advanced molecular and analytical techniques such as real-time PCR, metagenomics, whole genome sequencing, microarray, HPLC, XRD 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

The study focuses on drug resistant tuberculosis (MDR-TB), the condition at which the TB bacterium becomes resistant to treatment for the two most powerful first line drugs. 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. Out of 115 Ziehl-Neelsen stain positive sputum samples collected from newly diagnosed tuberculosis patients from Kandy and Welisara chest hospitals, 79 were culture positive and were preceded to drug susceptibility testing. Accordingly, 17 were resistant to at least one drug tested which included 1 Extensively Drug Resistant (XDR), 2 Multi-Drug Resistant. High confidence SNPs with relevance to above resistance patterns were identified via whole genome sequencing; for example, katG (key mutation at codon 315), embB (key mutation at codon 306), rpoB (key mutations at codons 445 and 545) etc. Transcriptome patterns were obtained and final sorting out is in progress.

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

The study aimed to identify the thermophilic microbial diversity in hot springs of Sri Lanka. Water and microbial mat samples were collected from six hot springs. 16S rRNA metagenomic sequencing revealed: a total of 25 phyla demonstrating 131 families with 159 genera in Mahapelessa (MP), Mahaoya (MO), Nelumwewa (NW) and Wahawa (WT) hot springs. The most abundant phylum was the Proteobacteria (84.6%-35.2%), followed by Firmicutes (23.7%-0.9%) and Chloroflexi (15.9%-0.4%). The most abundant genera were *Burkholderia* and *Desulfotomaculum.*

Figure 1: Bacterial diversity in hot springs

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

Water samples (N=57) and edible plant materials were collected from CKDu endemic Girandurukotte area. In the HPLC analysis, microcystin variants were showed in pellets (92%) and filtrates (85%) obtained through filtration of water samples. Only one filtrate sample collected from a CKDu patient was positive for nodularin. Potential microcystin, nodularin, cylindrospermopsin and anatoxin-a producing cyanobacterial genera have been tentatively identified by observing morphological characters of cultured cyanobacteria among CKDu (68%), CKD (36%) patients, healthy individuals (15%), reservoir water samples (18%) and other water sources (9%). Microcystin variants were showed in 50% *Centella asiatica* (Gotukola) samples, 75% *Pisum sativum* (pea) and all 33 collected rice samples in the HPLC analysis.

Figure 2: Water sample collection from a reservoir and a drinking water well

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

Project focuses on the impact of occupational asbestos exposure on the health of asbestos related industrial workers in Sri Lanka. An epidemiological study was conducted using data from 264 industrial workers in an asbestos manufacturing company in Sri Lanka. Air samples and deposition samples were also collected from the factory premises. The samples are being analyzed using SEM, Phase Contrast Microscopy, XRD, FTIR, and particle size analyzer. Asbestos fibers were observed from six samples under SEM analysis. ICP-OES analysis was done for all the collected deposition samples and available metal concentrations were identified.

Identification of urinary biomarkers for diabetic and hypertensive Chronic Kidney Disease (CKD) in Sri Lanka.

Chronic Kidney Disease (CKD) is a major global health problem. In Sri Lanka, the incidence rate of CKD has been increased rapidly in recent decades with high mortality rate. This study focuses two major underline risk factors related to CKD in Sri Lankan population: Diabetes and hypertension. The aim of this study is to identify biomarkers on urine samples of patients attending Nephrology clinic, District General Hospital, Vavuniya. A panel of genes will be used for gene expression analysis against a healthy control group.

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

As preliminary data, bacterial variations at two different heights; ground level and a rooftop site were tested. Airborne bacterial profiles and load were studied using real-time PCR and 16S rRNA amplicon sequencing. The rooftop site harbored ~1.4x higher bacterial load than that of the ground level site. Both sites were found to have site-specific bacterial species (37 and 22 on the rooftop site and ground site respectively). Assembly of GPS and SMS tracking system, sampler triggering system and the programming were finalized and tested. Date for the launch will be scheduled when the permission is granted by the Civil Aviation Authority and Telecommunication Regulation Commission.

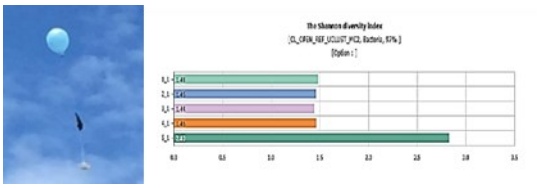

Figure 3: Balloon test run and Shannon diversity index of identified bacteria

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Key publications:

1. Madamarandawala, J.M.P.S., Satyanarayana, S., Timire, C., Yaqoob, A., Madegedara, R.M.D., and Magana-Arachchi, D.N. (2020). Is International Travel an Emerging Issue on Transmission of Beijing Lineage *Mycobacterium tuberculosis*? Journal of Tropical Medicine, 2020, p.1-8.
2. Ekanayake, E.M.U.A., Madegedara, R.M.D., Chandrasekharan, N.V., and Magana-Arachchi, D.N.* (2019). Respiratory Bacterial Microbiota and Individual Bacterial Variability in Lung Cancer and Bronchiectasis Patients. *Indian Journal of Microbiology*, p.1-10
3. Sayanthooran, S., Gunerathne, L., Abeysekera, T.D.J., Magana-Arachchi D.N. *(2018). "Transcriptome analysis supports viral infection and fluoride toxicity as contributors to chronic kidney disease of unknown etiology (CKDu) in Sri Lanka" *International Urology & Nephrology* (50) pp. 1667-1677

From L to R: Ms. M. Senevirathna, Ms. S. De Silva, Ms. P. Weerarathne, Mr. R. Harasgama, Dr. C. Thotawatthage, Ms. S. Samarasinghe, Ms. U. Ekanayake, Ms. H. Hettiarachchi , Ms. V. Koodalugodaarachchi
Seating: N. Thilakarathne, Prof. D. Magana-arachchi, Ms. P. Madamarandawala

Prof. Meththika Vithanage

Prof. Meththika Vithanage is the Founder/Director of the Ecosphere Resilience Research Centre, University of Sri Jayewardenepura. She was awarded the prestigious Fayzah M. Al-Kharafi award from The World Academy of Science (TWAS) in 2020. Her work has yielded important findings for successful application in the fields of agriculture, solid waste management, and environmental pollution remediation. Prof. Vithanage has contributed more than 125 SCI journal articles, 4 books and 30 book chapters. She has over 8200 citations and h-index is 41. Further, she is the leading scientist in the field of environmental sciences based on the scholarly output as stated in SCIVal, Elsevier.

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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. One SCI indexed article was published in 2020. 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.

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.

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. We conduct epidemiological and chemical research related to the workers and dust particles in the asbestos based industries in Sri Lanka with funds from the Ministry of Technology and Research.

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Nimanthika Samarasinghe is currently a Research Assistant reading for MPhil. in the Molecular Microbiology & Human Diseases research group at the National Institute of Fundamental Studies (NIFS). She received her B.Sc. (Special) degree from the University of Kelaniya, Sri Lanka in the same year and joined NIFS at 2018. Her research focuses on diversity and distribution of thermophilic microorganisms in hot springs of Sri Lanka. Her research interests include Molecular Microbiology and Metagenomics.

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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 and remains stagnant despite 95 percent of the rice crop extent being brought under improved cultivars. Cost of production of rice is very high in Sri Lanka; consequently, small scale farmers cannot break even, and this industry is on the verge of collapse. For the rice industry to survive, a yield increment of 6 MN/HA is required by 2025; otherwise, this industry will become unsustainable. Moreover, climate change (temperature and rainfall) has a major impact on rice production. In this scenario, the maximum possible yield achieved in farmers' fields has already been levelled off or has even declined in many regions. Currently, only traditional plant breeding techniques are widely adopted for crop improvement in Sri Lanka. However, a major knowledge gap in understanding key traits and genetic components contributing to rice yield and how physiological and molecular traits interact with the environment to maintain the yield potential in Sri Lankan cropping systems still remains. Owing to the negligence in the adaptation of scientific technology in plant breeding, advanced techniques like gene mapping, high throughput phenotyping, and gene editing based crop improvement, which are widely being used in the developed world are still not employed in Sri Lanka. Therefore, this project will create new knowledge to increase the yield potential of Sri Lankan rice through a combination of multidisciplinary approaches including transcriptomics, bioinformatics, biotechnology and plant physiology. This will be implemented by designing a new ideotype by identifying key physiological and biochemical traits associated with rice yield, transcriptome comparison and association mapping. The proposed study will provide fundamental knowledge and new concepts for plant breeders to develop high yielding rice varieties with improved tolerance to the adverse effects of climate change, which in turn will have immense socio-economic relevance.

Precision nitrogen management through environmental benign hybrid nanomaterial

Nitrogen (N) is the element required by plants in the highest quantity and its availability is one of the key limiting factors in crop productivity in agriculture. N also impacts crop yield by playing a major role in photosynthesis, accumulation of biomass, tillering, and development of spikelets. These processes are moderated by N utilization efficiency of the plant. N utilization in plants involves uptake, assimilation, translocation and remobilization. Nitrogen is taken up into the plants by roots via active transport systems which is an energy dependent process mediated by specific transporters. Most of the plants take up N in the form of NH_4^+ and NO_3^-. These two forms are taken up by the plants as NH_4^+ and/or NO_3^- in combination, but the ratio of uptake is ontogenetically regulated and also depends on the plant species (E. R. Alien, L. R. Hossner, D. W. Ming, 1993).

In agriculture systems, urea and urea-based fertilizers are the most commonly used nitrogen fertilizers due to low cost and high N availability. However, excess use of urea in agricultural systems leads to increased volatilization as well as leaching after application. Further, a large number of environmental impacts, including water eutrophication, soil degradation and increased levels of nitrous oxide contributing to global warming has been identified in various environments. Previous studies have shown that approximately 50-70% of N applied to the soil is lost, mainly due to surface run-off, leaching of nitrates, volatilization of ammonia etc., and cannot be utilized effectively by plants. Therefore, we propose to design a slow-release N fertilizer based on a novel concept of having biological synchronization using nanotechnology.

Aversive Geofencing Technology to Mitigate Human-elephant Conflict

Anthropogenic activities such as urbanization and agricultural expansion has affected wildlife populations in many different ways. While in some cases species tend to adapt to the changing environments and subsequently thrive, in other instances it has led to loss of species. With habitat loss and fragmentation, wild animals compete with humans for limited resources, resulting in conflict. The Asian Elephant (*Elephas maximus*) plays a major role in human-wildlife conflict across its range. This conflict has resulted in the death of both elephants and humans and large-scale damage to crops and property.

Electric fences are the most commonly used method to mitigate this conflict. However, they are expensive to build and maintain, create undesirable non-target impacts, and can be ineffective given that elephants sometimes learn to break these fences. The rise in incidents of conflicts with elephants has triggered the need to seek alternative and more flexible options to mitigate this problem. Aversive Geofencing Devices (AGDs-satellite linked warning collars) is a novel approach currently used on domestic farm animals for grazing management. 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 recent advancement in virtual fencing technology has the potential to revolutionize the management of human elephant conflict but requires field-testing and refinement. This project tests the AGD technology on captive elephants at Pinnawala Elephant Orphanage to determine its effectiveness in managing elephant movement. If successful, AGDs will then be tested on wild elephants to determine its effectiveness in managing elephant movement around human habitations.

From L to R: Ms. SC. de Mel, Ms. M. Perera, Prof. S. Seneweera, Ms. W. Welagedara, Ms. U. Nakandala

Ms. M. Perera

Maheshika Perera is a MPhil Research Assistant in the Plant Stress Biology and Molecular Genetics project. She obtained her BSc equivalent special degree from the Institute of Chemistry Ceylon in 2014. Maheshika began her scientific career by joining the Sri Lanka Institute of Nanotechnology as a Research Scientist. After 5 years of research experience, she joined NIFS in June 2019. Currently her research is focused on precision nitrogen management through environmental benign hybrid nonmaterial. Her research interests include Nanotechnology, Material Chemistry, Plant nutrients and Plant physiology.

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Ms. U. Nakandala

Upuli Nakandala is a PhD Research Assistant with the Plant Stress Biology and Molecular Genetics project at the NIFS. She obtained her B Sc (Special) in Molecular Biology and Biotechnology from the University of Peradeniya in 2017. She joined NIFS in June 2019. Upuli's research focuses on creating benchmark yield in paddy and other minor crops. Her research interests include plant breeding and genetics, DNA fingerprinting, crop physiology and functional genomics.

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Ms. L. S. J. Cabral de Mel

Surendranie is a PhD student registered at the University of Southern Queensland (USQ), Australia, and based at the National Institute of Fundamental Studies (NIFS). Her research interests lie in behavioural ecology, physiology and wildlife conservation. Sunrendranie obtained her BSc (Special degree) in Zoology from the University of Colombo in 2013 and was awarded a Commonwealth Shared Scholarship in 2014 to study for her Master of Research (MRes) degree in Wildlife Conservation at the University of Southampton, UK. She is conducting her PhD research project on efficacy and welfare of Aversive Geofencing Devices for managing the movements of Asian elephants.

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NIFS Adjunct Research Positions - 2020

Prof. Atula Sandanayake

Prof. Sandanayake, started his academic position at University of Sri Jayewardenepura, 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 supramolecular for artificial solar energy harvesting systems compose of porphyrin nanoarchitectures and carbon nanomaterials. Recently we are working on organic semiconductor laser- an area of physical chemistry, I am also working on the exploratory research for advance technology (ERATO) program of the Japan science and technology agency (JST) as a professor (research). I have succeeded to complete several research project in Japan Advance 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 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 count 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 National Health and Medical Research Council of Australia. He has supervised and/or mentored a number of PhD and MD students to successful completion and currently having 10 PhD students working in 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 Cosmology.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, and 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 focusses on climate change and its effects on crops and diseases. He is a leader in the field of plant pathology and 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 experi ence 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 the 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 replication stage in Sri Lanka with the 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 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. S. Dallavalle

Prof. Sabrina Dallavalle is full professor in Medicinal 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 sub stances. She has developed and successfully completed several interdis ciplinary 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 scientific works are mainly documented by 116 publications in international leading journals of organic and medicinal chemistry.Currently she has 2280 citations with 27 H-index in Google Scholar.

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, 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 United States, Europe and Japan and currently an Adjunct Professor of Physics at the Georgia State University. He has authored more than 300 publications and mentored the post -graduate 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 Biological 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 on Plant Physiology area, had been published 31 papers and one book chapter. Most of his research articles were published in high impact journal 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 PhD 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 and KAUST, 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 8326 citations (June 2019); H-index of 46.

Prof. Nor Hadiani Ismail

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 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). Prof Nor Hadiani is the recipient of UiTM Excellence Service Award 2002, 2006 and 2015. Prof Nor Hadiani has published 164 peer reviewed scientific publications in internationally reputed journals. Her publications have received 6201 citations with H index of 41. Prof Nor Hadiani 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 during 2012. For her outstanding achievements in natural products chemistry research, Prof Nor Hadiani was recently recognized as a Top Research Scientist Malaysia (2017) by the Academy of Science Malaysia. Currently, she is the Director of 'Atta-ur-Rahman Institute for Natural Product Discovery', UiTM's research center dedicated to research in natural product science.

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 the Western Sydney University, he worked at the Faculty of Pharmacy, University of Sydney after gaining years of postdoctoral experience as 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 Perad eniya, (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, 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–to date).

He was appointed as Visiting Research Professor, NIFS, Kandy, Sri Lanka (June 2015–April 2019). 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 283 peer-reviewed original research papers, 12 review articles, 12 books and book chapters and 11 patent applications.

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 students published over 280 papers in peer-reviewed journals. He is a core team member of the Joint Research and Demonstration Center at University of Peradeniya

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 interaction, 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 2020

NIFS Research and UN Sustainable Development Goals

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.

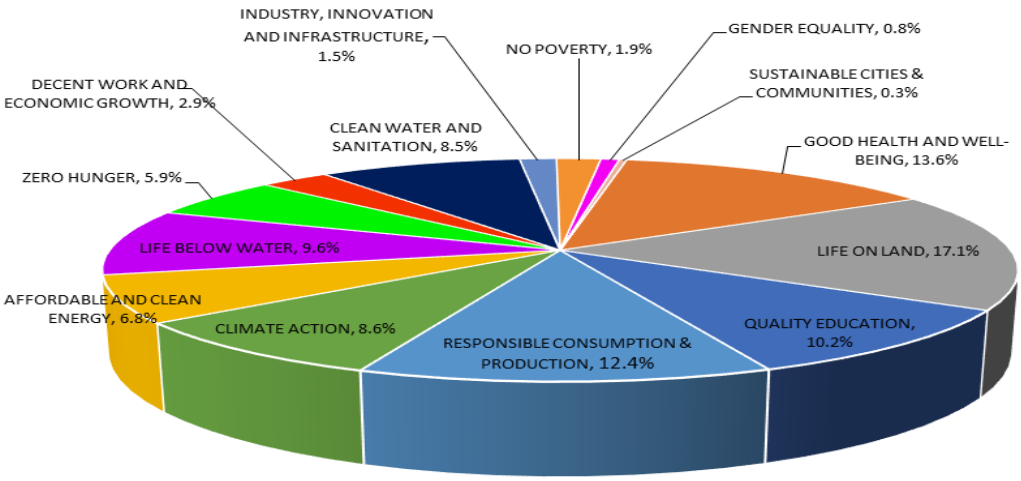
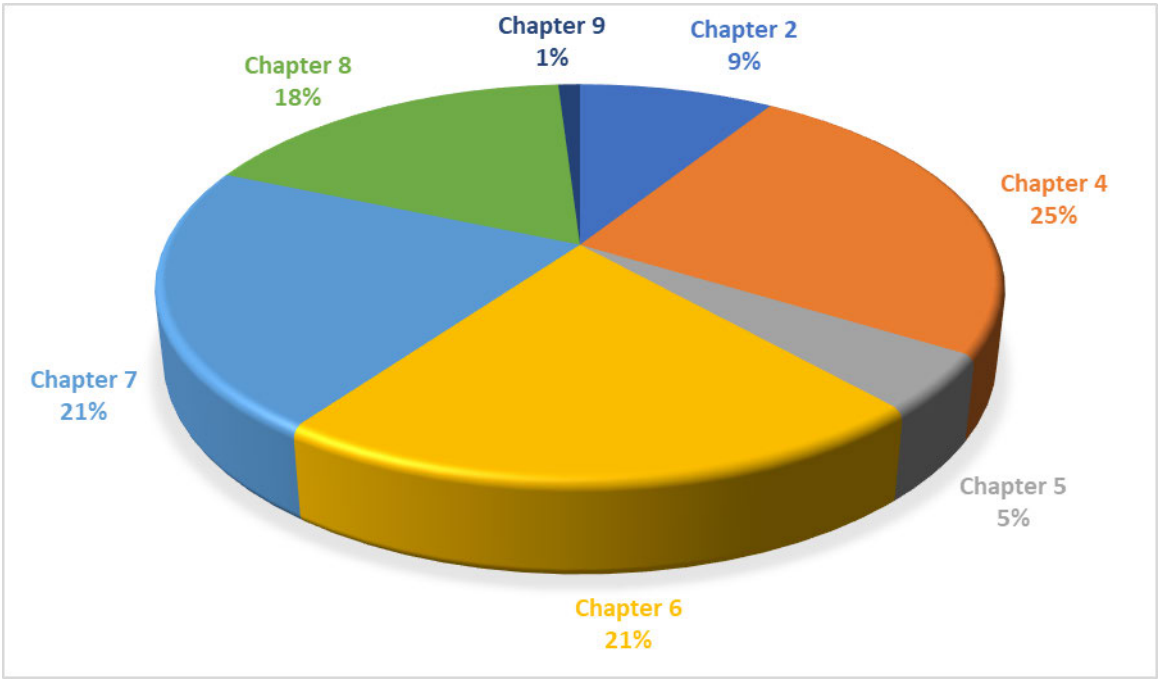


Figure 1. Achieving Sustainable Development Goals (SDGs) in 2020



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 2020

PUBLICATIONS IN JOURNALS 2020

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

ENERGY & ADVANCED MATERIALS RESEARCH UNIT

Condensed Matter Physics & Solid State Chemistry research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. **Dissanayake, M.A.K.L.,** Liyanage, T., Jaseetharan, T., **Senadeera, G.K.R.,** and Dassanayake, B.S. (2020). Effect of PbS quantum dot-doped polysulfide nanofiber gel polymer electrolyte on efficiency enhancement in CdS quantum dot-sensitized TiO_2 solar cells. *Electrochimica Acta*, 347, p.1-9. [SCI/SCIE, IF : 6.215, SJR : 1.467, Q1]
https://doi.org/10.1016/j.electacta.2020.136311

2. Bandara, T.M.W.J., Senavirathna, S.L.N., Wickramasinghe, H.M.N., Vignarooban, K., De Silva, L.A., **Dissanayake, M.A.K.L.,** Albinsson, I., and Mellander, B.-E. (2020). Binary counter ion effects and dielectric behavior of iodide ion conducting gel-polymer electrolytes for high-efficiency quasi-solid-state solar cells. *Physical Chemistry Chemical Physics*, 22, p.12532-12543.
[SCI/SCIE, IF : 3.430, SJR : 1.143, Q1]
http://www.doi.org/10.1039/d0cp01547d

3. Dhanawansha, K.B., **Senadeera, G.K.R.,** Gunathilake, S.S., and Dassanayake, B.S. (2020). Silver nanowire-containing wearable thermogenic smart textiles with washing stability. *Advances in Nano Research*, 9(2), p.123-131.
[SCI/SCIE, IF : 4.583, SJR : 0.779, Q1]
http://www.doi.org/10.12989/anr.2020.9.2.123

4. **Dissanayake, M.A.K.L.,** Kumari, J.M.K.W., **Senadeera, G.K.R.,** Jaseetharan, T., Mellander, B.E., Albinsson, I., and Furlani, M. (2020). Polyaniline (PANI) mediated cation trapping effect on ionic conductivity enhancement in poly(ethylene oxide) based solid polymer electrolytes with application in solid state dye sensitized solar cells. *Reactive and Functional Polymers*, 155, p.1-11.
[SCI/SCIE, IF : 3.333, SJR : 0.708, Q1]
https://doi.org/10.1016/j.reactfunctpolym.2020.104683

5. **Dissanayake, M.A.K.L.,** Jaseetharan, T., **Senadeera, G.K.R.,** Mellander, B.E., Albinsson, I., Furlani, M., and Kumari, J.M.K.W. (2020). Solid-state solar cells co-sensitized with PbS/CdS quantum dots and N719 dye and based on solid polymer electrolyte with binary cations and nanofillers. *Journal of Photochemistry & Photobiology, A: Chemistry*, 405, p.1-11.
[SCI/SCIE, IF : 3.306, SJR : 0.624, Q1]
https://doi.org/10.1016/j.jphotochem.2020.112915

6. Sarangika, H.N.M., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2020). Efficiency enhancement in dye-sensitized solar cells irrespective of the electrolyte medium by nanostructured tri-layer TiO_2 photoanode. *Ionics*, 26, p.4747-4755.
[SCI/SCIE, IF : 2.394, SJR : 0.493, Q1]
https://link.springer.com/article/10.1007/s11581-020-03620-7

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[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. indexed in scimago journal Ranking (SJR) database

7. Kumari, J.M.K.W., **Senadeera, G.K.R.,** Weerasinghe, A.M.J.S., Thotawatthage, C.A., and **Dissanayake, M.A.K.L.** (2020). Effect of polyaniline (PANI) on efficiency enhancement of dye-sensitized solar cells fabricated with poly(ethylene oxide)-based gel polymer electrolytes. *Journal of Solid State Electrochemistry*, p.1-11.
   [SCI/SCIE, IF : 2.646, SJR : 0.568, Q2]
   https://doi.org/10.1007/s10008-020-04841-6

8. **Dissanayake, M.A.K.L.,** Senthuran, S., and **Senadeera, G.K.R.** (2020). Efficiency enhancement in dye-sensitized solar cells using hierarchical TiO_2 submicron size spheres as a light scattering layer. *Journal of Solid State Electrochemistry*, 24, p.2261-2269.
   [SCI/SCIE, IF : 2.646, SJR : 0.568, Q2]
   https://doi.org/10.1007/s10008-020-04727-7

Publications in other refereed journals

9. **Senadeera, G.K.R.,** Thotawatthage, C.A., and **Dissanayake, M.A.K.L.** (2020). Efficiency enhancement in dye sensitized solar cells by light scattering in photoanode with TiO_2 nanotubes. *Journal of Physics: Conference Series*, 1552, p.1-12.
   http://www.doi.org/10.1088/1742-6596/1552/1/012002

10. **Dissanayake, M.A.K.L.** (2020). The Renewable Energy Revelution. *Ceylon Journal of Science*, 49(4), p.401-402.
    http://doi.org/10.4038/cjs.v49i4.7819

Energy & Advanced Material Chemistry research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Kulathunga, K.M.S.D.B., Yan, C.F., and **Bandara, J.** (2020). Photocatalytic removal of airborne indoor pollutants by IR illuminated silver coated TiO2 catalyst: Advantage of one-dimensional TiO2 nanostructures in IR active photocatalysis. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 590, p.1-9.
   [SCI/SCIE, IF : 3.990, SJR : 0.780, Q1]
   http://www.doi.org/10.1016/j.colsurfa.2020.124509

Publications in other refereed journals

2. Tan, H.Y., Zhan, L., Yan, C.F., Abeykoon, A.M.K.L., De Silva, N.L., and **Bandara, J.** (2020). Enhancement of the conversion of mechanical energy into chemical energy by using piezoelectric $KNbO_{3-x}$ with oxygen vacancies as a novel piezocatalyst. *Nano Express*, 1(3), p.1-16.
   http://www.doi.org/10.1088/2632-959X/abd290

Material Processing & Device Fabrication research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Kumarasinghe, K.D.M.S.P.K., de Silva, L.A., Perera, A.G.U., Tennakone, K., Dehipawala, S., and **Kumara, G.R.A.** (2020). Usage of Ionic Liquid Electrolyte in Tin and Zinc Oxide Composite Dye-sensitized Solar Cells. *Chemistry Letters*, 49(12), p.1470-1472.
   [SCI/SCIE, IF : 1.361, SJR : 0.465, Q2]
   http://www.doi.org/10.1246/cl.200535

Publications in other refereed journals

2. Madushani, A.A.B., Kumarasinghe, P., **Kumara, G.R.A.,** and Bandara, L.R.A.K. (2020). Fabrication of floated graphite/graphene based composite counter electrode for dye-sensitized solar cell. *International Research Journal of Engineering and Technology*, 7(4), p.2824-2829.
   https://www.irjet.net/archives/V7/i4/IRJET-V7I4545.pdf

3. Sirimanne, P.M., Dissanayake, P.N., and **Kumara, G.R.A.** (2020). Effect of Ligands attached to Fluorescein on the Photocurrent of Solid-State Dye-Sensitized Solar Cells. *International Journal of Science and Research*, 9(11), p.356-362.
https://www.ijsr.net/get_abstract.php?paper_id=SR201104171159

NATURAL PRODUCT & FOOD CHEMISTRY RESEARCH UNIT

Food Chemistry research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. *Deen, A., Visvanathan, R., Wickramarachchi, D, **Marikkar, J.M.N.,** Nammi, S, Jayawardana, B.C., and **Liyanage, R.** (2020). Chemical Composition and Health Benefits of Coconut oil: An Overview. *Journal of the Science of Food and Agriculture*, p.1-12.
[SCI/SCIE, IF : 2.614, SJR : 0.718, Q1]
http://www.doi.org/10.1002/jsfa.10870

2. **Marikkar, J.M.N.,** Nagaraja, R., Somawathie, H.P.T.D., Hewapathirana, H.P.T.D., Yalegama, L.L.W.C., Littardi, P., and Chiavaro, E. (2020). Effect of coconut testa flour on cookie characteristics. *Italian Journal of Food Science*, 32(2), p.209-221.
[SCI/SCIE, IF : 0.855, SJR : 0.329, Q3]
https://www.itjfs.com/index.php/ijfs/article/view/1694

Publications in other refereed journals

3. *Wimalaweera, U., Deen, A., Visvanathan, R., Sewwandi, S.M., Wickramanayeka, S., Wickramaarachi,D., **Marikkar, J.M.N.** N., Rathnayeka, I., Jayawardana, B.C., **Liyanage, R.** (2020). Comparison of fermentation properties in raw and boiled legumes after simulated digestion. *Ceylon Journal of Science*, 49(4), p.403-408.
http://doi.org/10.4038/cjs.v49i4.7820

Natural Products research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Napagoda, M., Gerstmeier, J., Butschek, H., De Soyza, S., Pace, S., Lorenz, S., Qader, M., Witharana, S., Nagahawatte, A., Wijayaratne, G., Svatoš, A., **Jayasinghe, L.,** Koeberle, A., and Werz, O. (2020). The Anti-Inflammatory and Antimicrobial Potential of Selected Ethnomedicinal Plants from Sri Lanka. *Molecules*, 25(8), p.1-22.
[SCI/SCIE, IF : 3.267, SJR : 0.698, Q1]
http://www.doi.org/10.3390/molecules25081894

2. Sathya, S., Amarasinghe, N. R., **Jayasinghe, L.,** Araya, H., and Fujimoto, Y. (2020). Enzyme inhibitors from the aril of *Myristica fragrans. South African Journal of Botany*, 130, p.172-176.
[SCI/SCIE, IF : 1.792, SJR : 0.479, Q2]
https://doi.org/10.1016/j.sajb.2019.12.020

3. **Adikaram, N.K.B.,** Manawadu,L., **Jayasinghe, L.,** and Yakandawala,D. (2020). First report of *Lasiodiplodia theobromae* rot in ripe jack fruit (*Artocarpus heterophyllus* Lam.) in Sri Lanka. *Indian Phytopathology*, 73, p.583–585.
[SJR : 0.153 , Q4]
http://www.doi.org/10.1007/s42360-020-00243-w

Publications in other refereed journals

4. **Adikaram, N.K.B.** (2020). Increased food security through minimized postharvest loss. *Ceylon Journal of Science*, 49(3), p.223.
http://www.doi.org/10.4038/cjs.v49i3.7772

5. **Adikaram, N.K.B.** (2020). Hundred and fifty years of Plant Pathology in Sri Lanka. *Ceylon Journal of Science*, 49(5), p.323-325.
http://doi.org/10.4038/cjs.v49i5.7799

6. **Adikaram, N.K.B.,** and Yakandawala, D. M. D. (2020). A check list of plant pathogenic fungi and oomycota in Sri Lanka. *Ceylon journal of Science*, 49(1), p.93-123.
http://doi.org/10.4038/cjs.v49i1.7709

7. **Adikaram, N.K.B.,** Yakandawala,D., and **Jayasinghe, L.** (2020). The first report of *Helvella crispa* (Ascomycota, Pezizales), a rare fungal species in Sri Lanka. *Ceylon Journal of Science*, 49(4), p.485–489.
http://doi.org/10.4038/cjs.v49i4.7829

8. **Adikaram, N.K.B.,** Yakandawala,D.M.D., and **Jayasinghe, L.** (2020). *Leucocoprinus birnbaumii* (Agaricales: Basidiomycota), attractive yellow houseplant mushroom, revisited after 100 years. *Ceylon Journal of Science*, 49(2), p.209–211.
http://www.doi.org/10.4038/cjs.v49i2.7742

9. Dissanayake, D., **Kumar, N.S., Adikaram, N.K.B., Jayasinghe, L.,** Araya, H., and Fujimoto, Y. (2020). Production of Small Molecules by an Endophytic Fungus, *Neofusicoccum parvum* from the Fruits of *Elaeocarpus serratus*. *Asian Journal of Traditional Medicines*, 15(2), p.47-54.
http://asianjtm.syphu.edu.cn/EN/Y2020/V15/I2/47

10. Kaliyadasa,P.E., Karunarathne,M.K., **Jayasinghe, L.,** and Marasinghe,P. (2020). Screening of different eco-types of *Munronia pinnata* (Wall) Theob. for important phytochemical properties. *International Journal Of Pharmaceutical Sciences And Research*, 11(4), p.1602-1609.
http://www.doi.org/10.13040/IJPSR.0975-8232.11(4).1602-09

11. Karunanayake, K. O. L. C., and **Adikaram, N.K.B.** (2020). Stem-end rot in major tropical and subtropical fruit species. *Ceylon Journal of Science*, 49(5), p.327–336.
http://doi.org/10.4038/cjs.v49i5.7800

12. Selvaskanthan, S., Kaushalya, D. B. R., Pushpakumara, D. K. N. G., **Jayasinghe, L.,** and Eeswara, J. P. (2020). A comparison of chemical profile of callus, plant and agarwood extracts of *gyrinops walla* using thin layer chromatography. *Tropical Agricultural Research*, 31(2), p.97-105.
https://tar.sljol.info/

13. Wickramasinghe, P., **Adikaram, N.K.B.,** and Yakandawala, D. (2020). Molecular characterization of Colletotrichum species causing Begonia anthracnose in Sri Lanka. *Ceylon Journal of Science*, 49(5), p.363–371.
http://doi.org/10.4038/cjs.v49i5.7803

Nutritional Biochemistry research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. *Deen, A., Visvanathan, R., Wickramarachchi, D, **Marikkar, J.M.N.,** Nammi, S, Jayawardana, B.C., and **Liyanage, R.** (2020). Chemical Composition and Health Benefits of Coconut oil: An Overview. *Journal of the Science of Food and Agriculture*, p.1-12.
[SCI/SCIE, IF : 2.614, SJR : 0.718, Q1]
http://www.doi.org/10.1002/jsfa.10870

2. Rizliya, V., Qader, M., Jayathilake, C., Jayawardana, B.C., **Liyanage, R.,** and Sivakanesan, R. (2020). Critical review on conventional spectroscopic alpha-amylase activity detection methods: merits, demerits and future prospects. *Journal of the Science of Food and Agriculture*, 100(7), p.2836-2847.
[SCI/SCIE, IF : 2.614, SJR : 0.718, Q1]
http://www.doi.org/10.1002/jsfa.10315

3. Thissera, B., Rizliya, V., Khanfar, M. A., Qader, M. M., Hassan, M. H. A., Hassan, H. M., Bawazeer, M., F. A. Behery, Yaseena, M., **Liyanage, R.,** Abdelmohsen, U. R., and Rateb, M. E. (2020). *Sesbania grandiflora* L. Poir leaves: A dietary supplement to alleviate type 2 diabetes through metabolic enzymes inhibition. *South African Journal of Botany*, 130, p.282-299.
[SCI/SCIE, IF : 1.792, SJR : 0.479, Q2]
http://www.doi.org/10.1016/j.sajb.2020.01.011

4. Jayarathna, S., Priyashantha, H. , Johansson, M., Vidanarachchi, J.K., Jayawardana, B.C., and **Liyanage, R.** (2020). Probiotic enriched fermented soy-gel as a vegan substitute for dairy yoghurt. *Journal of Food Processing and Preservation*, p.1-10.
[SCI/SCIE, IF : 1.405, SJR : 0.465, Q2]
https://doi.org/10.1111/jfpp.15092

Publications in other refereed journals

5. Lansakara, P., **Liyanage, R.,** Jayawardana, B. C. and Vidanarachchi, J. (2020). A comparative study on nutritional and nutraceutical properties of finger millet (*Eleusine coracana*) and rice (*Oryza sativa*). *World Journal of Biology Pharmacy and Health Sciences*, 1(01), p.017–024.
http://www.doi.org/10.30574/wjbphs.2020.1.1.0008

6. *Wimalaweera, U., Deen, A., Visvanathan, R., Sewwandi, S.M., Wickramanayeka, S., Wickramaarachi,D., **Marikkar, J.M.N.** N., Rathnayeka, I., Jayawardana, B.C., **Liyanage, R.** (2020). Comparison of fermentation properties in raw and boiled legumes after simulated digestion. *Ceylon Journal of Science*, 49(4), p.403-408.
http://doi.org/10.4038/cjs.v49i4.7820

MICROBIOLOGY & CARBON SEQUESTRATION RESEARCH UNIT

Microbial Biotechnology research project

Publications in other refereed journals

1. Henagamage, A.P., **Seneviratne, G.,** Abayasekera, C. (2020). Biofilmed Biofertilizers for Rhizo-Remediation and Consumer Health-Friendly Potato Production.
International Journal of Science and Research, 9(12), p.1118-1123.
https://www.ijsr.net/

2. Jayaneththi, J.P.H.U., **Seneviratne, G.,** Madawala, H.M.S.P., Amarasekara, M.G.T.S. (2020). Microbially Improved Phosphorus Fertilizer for Rice Cultivation. *International Journal of Research and Innovations in Earth Science*, 7(6), p.86-94.
https://www.ijries.org/index.php/issues?view=publication&task=show&id=106

3. Lokupitiya, E., Agrawal, M., Ahamed, T., Mustafa, N., Ahmed, B., Vathani, A., Opatha, K., Jaiswal, B., Suruchi Singh, S., **Seneviratne, G.,** DN Sirisena, D.N., Paustian, K. (2020). Evaluation of best manage ment practices with greenhouse gas benefits for salt-affected paddy soils in South Asia. *APN Science Bulletin*, 10(1), p.41-49.
https://www.apn-gcr.org/bulletin/article/evaluation-of-best-management-practices-with-greenhouse-gas-benefits-for-salt-affected-paddy-soils-in-south-asia/

4. Seneviratne, K.A.C.N., Kuruppu Arachchi, K.A.J.M., **Seneviratne, G.** and Premarathna, M. (2020). Zamioculcas zamiifolia novel plants with dwarf features and variegated leaves induced by colchicine. *Ceylon Journal of Science*, 49(2), p.203–207.
http://doi.org/10.4038/cjs.v49i2.7741

5. Singhalage, I.D., **Seneviratne, G.,** and Madawala, H.M.S.P. (2020). Functional heterogeneity of metabolites excreted by fungal and bacterial biofilms and their effects on seedling growth. *Ceylon Journal of Science*, 49(1), p.13-19.
http://www.doi.org/10.4038/cjs.v49i1.7701

Microbiology & Soil Ecosystems research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

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.
   [SCI/SCIE, IF : 3.170, SJR : 1.249, Q1]
   https://doi.org/10.1016/j.foreco.2020.118285

2. *Hossain, M.F., **Ratnayake, R.R.,** Mahbub, S., Kumara, K.L.W., and **Magana-Arachchi, D.N.** (2020). Identification and culturing of cyanobacteria isolated from freshwater bodies of Sri Lanka for biodiesel production. *Saudi Journal of Biological Sciences*, 27(6), p.1514-1520.
   [SCI/SCIE, IF : 2.802, SJR : 0.649, Q1]
   https://doi.org/10.1016/j.sjbs.2020.03.024

3. Paranavithana, T.M., Marasinghe, S., Perera, G.A.D, and **Ratnayake, R.R.** (2020). Effects of crop rotation on enhanced occurrence of arbuscular mycorrhizal fungi and soil carbon stocks of lowland paddy-fields in seasonaly dry tropics. *Paddy and Water Environment*, p.1-12.
   [SCI/SCIE, IF : 1.262, SJR : 0.502, Q2]
   http://www.doi.org/10.1007/s10333-020-00833-4

4. *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.
   [SCI/SCIE, IF : 1.438, SJR : 0.424, Q3]
   https://doi.org/10.4491/eer.2020.040

EARTH, ENVIRONMENT & BIODIVERSITY RESEARCH UNIT

Earth Resources and Renewable Energy research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Dharmapriya, P.L., Malaviarachchi, S., Galli, A., Kriegsman, L.M., Osanai, Y., Sajeev, K., Ben-Xun Su, Tsunogae, T., Zhang, C., Adachi, T., Dissanayake, C.B., and **Subasinghe, N.D.** (2020). Hybrid phase equilibria modelling with conventional and trace element thermobarometry to assess the P–T evolution of UHT granulites: An example from the Highland Complex, Sri Lanka. *Journal of Metamorphic Geology*, , p.1–38.
   [SCI/SCIE, IF : 4.046, SJR : 2.784, Q1]
   http://www.doi.org/10.1111/jmg.12569

Environmental Science Research Programme

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Clark, D.P.Q., Son, D.B., **Bowatte, G.,** Senaratna, C.V., Lodge, C., Perret, J.L., Hamilton, G.S., and Dharmage, S. (2020). The association between traffic-related air pollution and obstructive sleep apnea: A systematic review. *Sleep Medicine Reviews*, 54, p.1-10.
   [SCI/SCIE, IF : 9.613, SJR : 3.567, Q1]
   http://www.doi.org/10.1016/j.smrv.2020.101360

2. Lodge, C.J., Lowe, A.J., Milanzi, E., **Bowatte, G.,** Abramson, M.J., Tsimiklis, H., Axelrad, C., Robertson, B., Darling, A.E., Svanes, C., Wjst, M., Dharmage, S.C., and Bode, L. (2020). Human milk oligosaccha ride profiles and allergic disease up to 18 years. *Journal of Allergy and Clinical Immunology*, p.1-8.
   [SCI/SCIE, IF : 10.228, SJR : 3.700, Q1]
   http://www.doi.org/10.1016/j.jaci.2020.06.027

3. Dai,X., Bui,D.S., Perret,J. L., Lowe, A.J., Frith,P.A., **Bowatte, G.,** Thomas,P.S., Giles,G.G. Hamilton,G.S., Tsimiklis,H., Hui,J. Burgess,J., Win, A.K., Abramson, M.J., Walters, E.H. Dharmage,S.C. and Lodge,C. J. (2020). Exposure to household air pollution over 10 years is related to asthma and lung function de cline. *European Respiratory Journal*, 57(1), p.1-12.
SCI/SCIE, IF : 12.339, SJR : 3.398, Q1]
http://www.doi.org/10.1183/13993003.00602-2020

4. Peralta, G.P., Marcon, A., Carsin, A.E., Abramson, M.J., Accordini, S., Amaral, A.F.S., Antó, J.M, **Bowatte, G.,** Burney, P., Corsico, A., Demoly, P. Dharmage, S., Forsberg, B., Fuertes, E., Garcia-Larsen, V., Gíslason, T., Gullón, J.A. Heinrich, J., Holm, M., Jarvis, D.L., Janson, C. Jogi, R., Johannessen, A., Leynaert, B. Rovira, J.M. M., Nowak, D., Probst-Hensch, N. Raherison, C., Sánchez-Ramos, J.L., Sigsgaard, T. Siroux, V., Squillacioti, G., Urrutia, I., Weyler, J. and Zock (2020). Body mass index and weight change are associated with adult lung function trajectories: The prospective ECRHS study. *Thorax*, 75(4), p.313-320.
[SCI/SCIE, IF : 8.834, SJR : 3.248, Q1]
http://www.doi.org/10.1136/thoraxjnl-2019-213880

5. Zhi-Wen Wang, Hong-Jin Liu, Chun-Yang Li, Xing Chen, **Weerasooriya, R.** Juan Wei, Jun Lv, Pin Lv, Yu-Cheng Wu (2020). Mesoporous g-C3N4/?-CD nanocomposites modified glassy carbon electrode for electrochemical determination of 2,4,6-trinitrotoluene. *Talanta*, 208, p.1-9.
[SCI/SCIE, IF : 5.339, SJR : 1.178, Q1]
http://www.doi.org/10.1016/j.talanta.2019.120410

6. Cui, K., Dai, R., Liu, X., **Weerasooriya, R.,** Hong, Z., Chen, X., Wu, Y. (2020). New strategy for fabricating Cd(II) sensing electrochemical interface based on enhanced adsorption followed by redox processes: Ferrocerium oxide nanocomposite as an example. *Journal of Alloys and Compounds*, 829, p.1-8.
[SCI/SCIE, IF : 4.650, SJR : 1.055, Q1]
https://doi.org/10.1016/j.jallcom.2020.154551

7. Kannangaraa, I., Jayawardhana, Y, Munasinghe, E., Rajapakshe, A., Bandara, A., **Weerasooriya, R.,** and **Jayarathna, L.** (2020). Synthesis and characterization of nano zeolite-A with aid of sodium dodecyl sulfate (SDS) as particle size-controlling agent. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 589, p.1-6.
[SCI/SCIE, IF : 3.990, SJR : 0.780, Q1]
https://doi.org/10.1016/j.colsurfa.2020.124427

Publications in other refereed journals

8. Halpegama, J.U., Bandara, P.M.C.J., **Jayarathna, L.,** Bandara, A., Yeh, C.-U., Chen, J.-Y, Kuss, C., Dahanayake, U., Herath, A.C., Weragoda, S.K., Chen, X., and **Weerasooriya, R.** (2020). Facile fabrication of nano zerovalent iron – Reduced graphene oxide composites for nitrate reduction in water. *Environmental Advances*, 3, p.1-8.
https://doi.org/10.1016/j.envadv.2020.100024

9. Libing, Z., Titus, C., Hui, Z., Weragoda, S., **Weerasooriya, R.,** and Mahkehelwala, M. (2020). Critical challenges and solutions on ground drinking water in chronic kidney disease of unknown etiology (CKDu) affected regions in Sri Lanka. *Chinese Journal of Environmental Engineering*, 14(8), p.2100-2111.
http://www.doi.org/10.12030/j.cjee.202006089

Evolution, Ecology & Biodiversity research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Maddison, W.P., Beattie, I., Marathe, K., Ng, P.Y.C., Kanesharatnam, N., **Benjamin, S.P.,** and Kunte, K. (2020). A phylogenetic and taxonomic review of baviine jumping spiders (Araneae, Salticidae, Baviini). *ZooKeys*, 1004, p.27-97.
   [SCI/SCIE, IF : 1.137, SJR : 0.599, Q2]
   http://www.doi.org/10.3897/zookeys.1004.57526

2. Ranasinghe, U.G.S.L., Eberle, J., **Benjamin, S.P.,** and Ahrens, D. (2020). New species of Sericini from Sri Lanka (Coleoptera, Scarabaeidae). *European Journal of Taxonomy*, 621, p.1-20.
   [SCI/SCIE, IF : 1.393, SJR : 0.586, Q2]
   https://doi.org/10.5852/ejt.2020.621
3. **Benjamin, S.P.** (2020). Distributional and taxonomic notes on the crab spider genus *Talaus Simon,* 1886 with description of a new species (Araneae: Thomisidae). *ZOOTAXA*, 4858(3), p.405-416. [SCI/SCIE, IF : 0.000, SJR : 0.578, Q2]
   https://doi.org/10.11646/zootaxa.4858.3

4. Kanesharatnam, N., and **Benjamin, S.P.** (2020). First record of *Synagelides* Strand, 1906 (Araneae: Salticidae) from Sri Lanka: description of four endemic species from tropical wet forest of the island. *ZOOTAXA*, 4790(1), p.043-056.
   [SCI/SCIE, IF : 0.000, SJR : 0.578, Q2]
   https://doi.org/10.11646/zootaxa.4790.1.2

Publications in other refereed journals

5. Kanesharatnam, N., and **Benjamin, S.P.** (2020). On three new species of jumping spiders of the genera Habrocestum Simon, 1876, Stenaelurillus Simon, 1886 and Tamigalesus Zabka, 1988 (Araneae, Salticidae) from Sri Lanka. *Evolutionary Systematics*, 4(1), p.5-19.
   http://www.doi.org/10.3897/evolsyst.4.47578

Plant & Environmental Sciences research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Udayanga, L., Gunathilaka, N., **Iqbal, M.C.M.,** and Abeyewickreme, W. (2020). Climate change induced vulnerability and adaption for dengue incidence in Colombo and Kandy districts: the detailed investigation in Sri Lanka. *Infectious Diseases of Poverty*, 9(102), p.1-17.
   [SCI/SCIE, IF : 3.067, SJR : 1.435, Q1]
   http://www.doi.org/10.1186/s40249-020-00717-z

2. Udayanga, L., Subashinie Aryaprema, Nayana Gunathilaka, **Iqbal, M.C.M.,** Thilan Fernando, and W. Abeyewickreme (2020). Larval Indices of Vector Mosquitoes as Predictors of Dengue Epidemics: An Approach to Manage Dengue Outbreaks Based on Entomological Parameters in the Districts of Colombo and Kandy, Sri Lanka. *BioMed Research International*, 2020, p.1-11.
   [SCI/SCIE, IF : 2.276, SJR : 0.681, Q2]
   http://www.doi.org/10.1155/2020/6386952

3. Wijesinghe, K.E.H., Dissanayake, D.M.R.E.A., Iqbal, S.S., Priyantha, N., and **Iqbal, M.C.M.** (2020). Adsorption of phosphates from water by two polymer-silicate composites. *Bioremediation Journal*, p.231-250.
   [SCI/SCIE, IF : 1.724, SJR : 0.332, Q2]
   http://www.doi.org/10.1080/10889868.2020.1811631

Plant Taxonomy & Conservation research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals and SCI/SCIE

1. Wijayawardene, N. N., Hyde, K. D., Al-Ani, L. K. T, Tedersoo, L., Haelewaters, D., Rajeshkumar, K. C., Zhao, R. L., Aptroot, A., Leontyev, D. V., Saxena, R. K., Tokarev, Y. S., Dai, D. Q., Letcher, P. M., Stephenson, S. L., Ertz, D., Lumbsch, H. T., Kukwa, M., Issi, I. V., Madrid, H., Phillips, A. J. L., Selbmann, L., Pfliegler, W. P., Horváth E., Bensch, K., Kirk, P. M., Kolaříková, K., Raja, H. A., Radek, R., Papp, V., Dima, V, and **Wijesundara, D.S.A.** (2020). Outline of Fungi and fungus-like taxa. *Mycosphere*, 11(1), p.1060-1456.
   [SCI/SCIE, IF : 2.092, SJR : 1.151, Q1]
   http://www.mycosphere.org/pdf/MYCOSPHERE_11_1_8-1.pdf

2. Tennakoon, T.M.S.G., Gunaherath, G.M.K.B., De Silva, K.T.D., Padumadasa, C., **Wijesundara, D.S.A.,** and Abeysekera, A. M. (2020). Auto-oxidation of Ent-beyer-15-en-19-al isolated from the essential oil of the heartwood of *Erythroxylum monogynum* Roxb.: formation of 15,16-epoxy-ent-beyeran-19-oic acid and other products. *BMC Chemistry*, 14(18), p.1-12.
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Publications in other refereed journals

3. Liyanagamage, D. S. N. K., Jayasinghe, S., Attanayake, A. P., Karunaratne, V., and **Wijesundara, D.S.A.** (2020). Antihyperglycemic activity of fruit extracts of Sri Lankan endemic species *Garcinia quaesita Pierre* "Rathgoraka" and its isolated compound, garcinol. *Ceylon Journal of Science*, 49(3), p.303-309.
   http://doi.org/10.4038/cjs.v49i3.7781

4. Peiris, M. U. H., Dangalle, C. D., Pallewatta, N., and **Wijesundara, D.S.A.** (2020). Diversity of butterflies in different habitat types of Seethawaka wet zone botanic gardens and Indikadamukalana forest reserve of Sri Lanka. *Ceylon Journal of Science*, 49(1), p.49-59.
   http://doi.org/10.4038/cjs.v49i1.7705

5. Wijewickrama, M. P. T., Karunaratne, W. A. I. P, **Wijesundara, D.S.A.,** and and Madawala, H.M.S.P. (2020). *Bambusa bambos* (L.) Voss. alters Structure and composition of native forests: A study from moist evergreen forests in Sri Lanka. *Ceylon Journal of Science*, 49(2), p.173-184.
   http://doi.org/10.4038/cjs.v49i2.7738

Primate Biology research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. **Dittus, W.P.J.** (2020). Shields on electric posts prevent primate deaths: a case study at Polonnaruwa, Sri Lanka. *Folia Primatologica*, 91, p.643-653.
   [SCI/SCIE, IF : 1.148, SJR : 0.374, Q2]
   http://www.doi.org/10.1159/000510176

MOLECULAR BIOLOGY & BIOTECHNOLOGY RESEARCH UNIT

Molecular Microbiology & Human Diseases research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Weerasooriyagedara, M., Ashiq, A., Rajapaksha, A.U., Wanigatunge, R., Agarawal, T., **Magana-Arachchi, D.N.,** and **Vithanage, M.** (2020). Phytoremediation of fluoride from the environmental matrices: A review on its application strategies. *Groundwater for Sustainable Development*, 10, p.1-11.
   [SJR : 0.865 , Q1]
   http://www.doi.org/10.1016/j.gsd.2020.100349

2. *Hossain, M.F., **Ratnayake, R.R.,** Mahbub, S., Kumara, K.L.W., and **Magana-Arachchi, D.N.** (2020). Identification and culturing of cyanobacteria isolated from freshwater bodies of Sri Lanka for biodiesel production. *Saudi Journal of Biological Sciences*, 27(6), p.1514-1520.
[SCI/SCIE, IF : 2.802, SJR : 0.649, Q1]
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3. Madamarandawala, J.M.P.S., Satyanarayana, S., Timire, C., Yaqoob, A., Madegedara, R.M.D., and **Magana-Arachchi, D.N.** (2020). Is International Travel an Emerging Issue on Transmission of Beijing Lineage Mycobacterium tuberculosis? *Journal of Tropical Medicine*, 2020, p.1-8.
[SCI/SCIE, IF : 1.233, SJR : 0.541, Q2]
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4. *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.
[SCI/SCIE, IF : 1.438, SJR : 0.424, Q3]
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Publications in other refereed journals

5. Weerasinghe, M.A.Y.N., and **Magana-Arachchi, D.N.** (2020). Impact of microbial communities of public health importance in wild bird droppings - A complication in urban landscapes. *WILDLANKA*, 8(1), p.1-12.
http://journals.dwc.gov.lk/page.php?t=c&f=showArticle&id=138

6. **Wickramasinghe, N.C., Magana-Arachchi, D.N.,** Temple, R., Wallis, D.H., Steele, E.J., **Vithanage, M.,** Gorczynski, R.M., Tokoro, G., Klyce, B., and Slijepcevic, P. (2020). The Search for Bacteria and Viruses in the Stratosphere. *Advances in Astrophysics*, 5(2), p.57-62.
https://dx.doi.org/10.22606/adap.2020.52003

7. **Wickramasinghe, N.C.,** Steele, E.J., Nimalasuriya, A., Gorczynski, R.M., Tokoro, G., Temple, R., and Wainwright, M. (2020). Seasonality of Respiratory Viruses Including SARS-CoV-2. *Virology: Current Research*, 4(2), p.1-6.
https://www.hilarispublisher.com/open-access/seasonality-of-respiratory-viruses-including-sarscov2-51923.html

8. **Wickramasinghe, N.C.,** Steele, E.J., Gorczynski, R.M., Temple, R., Tokoro, G., Wallis, D.H., and Klyce, B. (2020). Growing Evidence against Global Infection-Driven by Person-to-Person Transfer of COVID-19. *Virology: Current Research*, 4(1), 110.
https://www.hilarispublisher.com/open-access/growing-evidence-against-global-infectiondriven-by-persontoperson-transfer-of-covid19-33386.html

9. **Wickramasinghe, N.C.,** Steele, E.J., Gorczynski, R.M., Temple, R., Tokoro, G., Qu, J., Wallis, D.H., and Klyce, B. (2020). Comments on the Origin and Spread of the 2019 Coronavirus. *Virology: Current Research*, 4(1), 109.
https://www.hilarispublisher.com/open-access/comments-on-the-origin-and-spread-of-the-2019-coronavirus-33365.html

10. **Wickramasinghe, N.C.,** Wallis, D.H., Coulson, S.G., Kondakov, A., Steele, E.J., Gorczynski, R.M., Temple, R., Tokoro, G., Klyce, B., and Slijepcevic, P. (2020). Intercontinental Spread of COVID-19 on Global Wind Systems. *Virology: Current Research*, 4(1), 113.
https://www.hilarispublisher.com/open-access/intercontinental-spread-of-covid19-on-global-wind-systems-45198.html

11. **Wickramasinghe, N.C.,** Steele, E.J., Gorczynski, R.M., Temple, R., Tokoro, G., Kondakov, A., Wallis, D.H., Klyce, B., and Wickramasinghe, D.T. (2020). Predicting the Future Trajectory of COVID-19. *Virology: Current Research*, 4(1), 111.
https://www.hilarispublisher.com/open-access/predicting-the-future-trajectory-of-covid19-44601.html

Plant Stress Biology & Molecular Genetics research project

Published in journal with Scientific Journal Ranking (SJR) index and included in Q journals

1. Kumarathilaka, P, Bundschuh, J, **Seneweera, S,** and Ok, Y. S (2020). An integrated approach of rice hull biochar-alternative water management as a promising tool to decrease inorganic arsenic levels and to sustain essential element contents in rice. *Journal of Hazardous Materials*, , p.1-9.
[SCI/SCIE, IF : 9.038, SJR : 2.010, Q1]
https://doi.org/10.1016/j.jhazmat.2020.124188

2. Hamawand, I, **Seneweera, S,** Kumarasinghe, P, and Bundschuh, J (2020). Nanoparticle technology for separation of cellulose, hemicellulose and lignin nanoparticles from lignocellulose biomass: A short review. *Nano-Structures & Nano-Objects*, 24, p.1-5.
[SJR : 0.808, Q1]
http://www.doi.org/10.1016/j.nanoso.2020.100601

3. Rudran, R., Cabral de Mel, S.J., Salindra, H.G, Dayananda, K., Ratnayake, R.M.R.R., Weerakkody, S, and de Mel, R.K. (2020). An Ethnoprimatological Approach to Conserving Sri Lanka's Critically Endangered Western Purple-Faced Langur. *Primate Conservation*, 34, p.227-233. [
[SJR : 0.232, Q3]
http://www.primate-sg.org/primate-conservation-34/

Publications in other refereed journals

4. Wijesundara, W. M. D. A., Nakandala, N.D.U.S., Wijesundara, W.W.M.U.K, Nawanjana, P.W.I, Ranaweera, L.T., Jayarathne, H.S.M., Rathnayake, P.G.R.G., Weebadde, C.K., Wickkramaarachchi, W.A.R.T., and Sooriyapathirana, S.D.S.S. (2020). Establishment of apple as an appealing cash crop in Sri Lanka: need, challenges, and opportunities. *Ceylon Journal of Science*, 49(4), p.409-421.
http://www.doi.org/10.4038/cjs.v49i4.7821

ABSTRACTS 2020

*: NIFS Inter Project Collaboration

ENERGY & ADVANCED MATERIALS RESEARCH UNIT

Condensed Matter Physics and Solid State Chemistry research project

1. *Jayamaha, J.H.T.B., Menisha, G., Keppetiyawa, K.G.H.S., Senavirathna, S.L.N., Vignarooban, K., Sashikesh, G., Veluathamurthy, K., **Wijayasinghe, H.W.M.A.C.,** and **Dissanayake, M.A.K.L.** (2020). Poly (methyl methacrylate) based gel-polymer electrolytes for sodium-ion secondary batteries - A comparative study with different ionic salts. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

2. Jaseetharan, T., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2020). Efficiency enhancement in dye-sensitized solar cells by co-sensitization with CdS quantum dots. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

3. Kumari, J.M.K.W., **Dissanayake, M.A.K.L., Senadeera, G.K.R.,** and Thotawatthage, C.A. (2020). Efficiency enhancement in dye sensitized solar cells with blended PVdF-HFP and PEO gel electrolytes. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

4. Kumarasinghe, I.G.H.U., Bandara, L.R.A.K., Bandara, T.M.W.J., **Senadeera, G.K.R.,** and Thotawatthage, C.A. (2020). Fabrication of Polyvinylidine Fluoride piezoelectric film for nanogenerators. *Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

5. *Menisha, G.,, Jayamaha, J.H.T.B., Veluathamurthy,G.,, Sashikesh, G., Veluathamurthy, K., **Wijayasinghe, H.W.M.A.C.,** and **Dissanayake, M.A.K.L.** (2020). Gel Polymer Electrolytes for Sodium Batteries - Raman and Electrochemical Impedance Spectroscopic Studies. *Japan, 9th International Conference on Material Science and Engineering Technology*.

6. Senthuran, S., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2020). Photoanode with hybrid TiO2 nanoparticles/hierarchically structured TiO2 microspheres for efficient dye-sensitized solar cells. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

7. Shashintha, H.T.G., Sarangika, H.N.M., Perera, V.P.S., **Dissanayake, M.A.K.L., Senadeera, G.K.R.,** and Kumari, J.M.K.W. (2020). Gel polymer electrolytes based on fumed silica filler for magnesium batteries. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

8. Umair, K., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2020). Acetonitrile free liquid electrolyte for dye-sensitized solar cells. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

9. Umair, K., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2020). Efficiency enhancement in SnO2 based dye-sensitized solar cells by incorporating plasmonic gold nanoparticles. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

Energy & Advanced Material Chemistry research project

1. Farhana, M.A., and **Bandara, J.** (2020). Dependence of performance of Sb_2S_3 thin film solar cell on blocking TiO_2 layer. *Uva Wellassa University, Proceeding of the International Research Conference of Uva Wellassa University.*

Material Processing & Device Fabrication research project

1. Aththanayake, A.A.A.P., Bandara, T.M.W.J., Samarasekara, P, and **Kumara, G.R.A.** (2020). Electrical and Optical Properties of F-doped SnO_2 Nanostructured Thin Films Synthesized by Sequential Nebulizer Spray Pyrolysis. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Aththanayake, A.A.A.P., De Silva, A., Tennakone, K., **Kumara, G.R.A.,** Bandara, T.M.W.J., and Samarasekara, P. (2020). Transparent and Conductive F-Doped SnO2 Nanostructured Thin Films by Sequential Nebulizer Spray Pyrolysis. *Virtual MRS Spring/Fall Meeting & Exhibit*.

3. Dissanayake, P.N., **Kumara, G.R.A.,** and Sirimanne, P.M. (2020). Enhancement of efficiency of zinc oxide-based photo-electrochemical cell by coupling of multiple dyes. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

4. Dissanayake, P.N.,**Kumara, G.R.A.,**and Sirimanne, P.M. (2020). Enhancing efficiency of solid-state dye-sensitized solar cells using dye cocktail with seven dyes.*National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

5. Dissanayake, P.N.,**Kumara, G.R.A.,**Karunarathne, D.G.B.C., Kumarasinghe, K.D.M.S.P.K., and Sirimanne, P.M. (2020). Low cost counter electrode for dye-sensitized solar cells using activated coconut shell charcoal with jackfruit latex as the binder.*University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

6. Dissanayake, P.N., Sirimanne, P.M., Tennakone, K., Karunarathne, D.G.B.C., Kumarasinghe, K.D.M.S.P.K., and **Kumara, G.R.A.** (2020). Enhancing the capacitance of activated charcoal powder based capacitors by varying amount of jack fruit latex binder.*National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

7. Karunarathne, D.G.B.C., Tennakone, K., Rajapake, R.M.G., and **Kumara, G.R.A.** (2020). Low-Cost Perovskite Solar Cells Based on Activated Coconut Shell Charcoal as the Hole-Transport Layer. *Post Graduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress, Sri Lanka*.

Nanotechnology & Physics of Materials research project

1. Bandara, T.G.T.A., Naranpanawa, H.M.H.D.K., Hewathilake, H.P.T.S., **Wijayasinghe, H.W.M.A.C.,** and Balasooriya, N.W.B. (2020). Comparison of the developed coarse flake of radial graphite with the developed needle platy graphite as the anode material of Li-ion rechargeable battery. *Uva Wellassa University, Proceedings of the International Research Conference of Uva Wellassa University*.

2. Gamlath, J.G.V.I., Swarnamali, V.M.R., Amaraweera, T.H.N.G., Premetilake, M.M.S.N., **Wijayasinghe, H.W.M.A.C.,** and Balasooriya, N.W.B. (2020). Synthesis of silver-graphite composite via ultrasonication associated chemical reduction and study of its antibacterial properties. *Uva Wellassa University, Proceeding of the International Research Conference of Uva Wellassa University*.

3. *Jayamaha, J.H.T.B., Menisha, G., Keppetiyawa, K.G.H.S., Senavirathna, S.L.N., Vignarooban, K., Sashikesh, G., Veluathamurthy, K., **Wijayasinghe, H.W.M.A.C.,** and **Dissanayake, M.A.K.L.** (2020). Poly (methyl methacrylate) based gel-polymer electrolytes for sodium-ion secondary batteries - A comparative study with different ionic salts. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

4. *Menisha, G.,, Jayamaha, J.H.T.B., Veluathamurthy,G.,, Sashikesh, G., Veluathamurthy, K., **Wijayasinghe, H.W.M.A.C.,** and **Dissanayake, M.A.K.L.** (2020). Gel Polymer Electrolytes for Sodium Batteries - Raman and Electrochemical Impedance Spectroscopic Studies. *Japan, 9th International Conference on Material Science and Engineering Technology*.

5. Naranpanawa, H.M.H.D.K., Amaraweera, T.H.N.G., **Wijayasinghe, H.W.M.A.C.,** and Balasooriya, N.W.B. (2020). Scaling-up and optimization of acid leaching method for purification of vein graphite for the Li-ion battery application. *Geological Society of Sri Lanka, Proceeding of the 36th Annual Technical Sessions of Geological Society of Sri Lanka*.

6. Naranpanawa, H.M.H.D.K., **Wijayasinghe, H.W.M.A.C.,** Balasooriya, N.W.B., and Amaraweera, T.H.N.G. (2020). Enhancing performance of rechargeable lithium-ion batteries by alkali roasting and acid leaching of vein graphite. *Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress Sri lanka*.

7. *Weerarathne, W.B.C.P., **Vithanage, M., Wijayasinghe, H.W.M.A.C.,** and **Magana-Arachchi, D.N.** (2020). Particulate matter analysis in air of a high-density chrysotile asbestos related production factory in Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

8. Weerarathne, W.B.C.P., **Vithanage, M., Wijayasinghe, H.W.M.A.C.,** Madegedara, R.M.D., and **Magana-Arachchi, D.N.** (2020). An insight into chemical and physical properties of atmospheric depositions in an asbestos roofing factory in Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, 2nd International conference of Environmental Monitoring and Management - EMM2020*.

9. *Wijekoon, H.S., Rathnayake, R.A., **Wijayasinghe, H.W.M.A.C.,** and **Subasinghe, N.D.** (2020). Com bined Molecular Dynamics – Representative Volume Element Modeling of Thermal Conduction of Gra phene Monolayer Deposited on an Amorphous Silicon Dioxide Substrate. *National Institute of Funda mental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium.*

NATURAL PRODUCT & FOOD CHEMISTRY RESEARCH UNIT

Food Chemistry research project

1. *Gunarathne, K.M.R.U, **Marikkar, J.M.N., Jayarathna, L.,** Yalegama, L.L.W.C., and Mendis, B.E.P. (2020). Differentiation of coconut testa flour and its lipid component of selected Sri Lankan coconut cultivars by FTIR spectroscopy. *Institute of Chemistry Ceylon, Proceedings of the 1st International Conference on Frontiers in Chemical Technology*.

2. Marasinghe, S.S.K., **Marikkar, J.M.N.,** and Wimalasiri, S. (2020). Comparison of water and oil absorption capacities of partially defatted coconut testa flour from selected Sri Lankan coconut cultivars. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

3. **Marikkar, J.M.N.**, Nurhaffizulullah,A.A, Gunarathna, K.M.R.U. (2020). Evaluation of the bran extracts of rice (*Oryza sativa L.*) and selected bean (*Phaseolus vulgaris* L.) varieties for their anti-oxidative and anti-hyperglycemic potentials. *University of Jaffna, 6th International Conference on Dry Zone Agriculture 2020*.

4. *Marasinghe, S.S.K., **Marikkar, J.M.N.,** Wimalasiri, S., **Jayasinghe, L.,** and **Liyanage, R.** (2020). Comparison of Antioxidant Properties of Coconut Testa Flour of Selected Local Coconut Cultivars of Sri Lanka.*MDPI , Proceedings of The Third International Tropical Agriculture Conference*.

Natural Products research project

1. Kaushalya, H.S.T., Dissanayake,D., **Adikaram, N.K.B.,** Kumar,N.S., **Jayasinghe, L.,** Araya, H., and Fujimoto, Y. (2020). Enzyme inhibitory activity of two carbazole alikaloids isolated from *Murraya koenigii* (Curry leaves). *Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Kehelpannala, C., Dissanayake, D., Kanatiwela, D., Kumar, N.S., **Adikaram, N.K.B., Jayasinghe, L.,** Araya, H., and Fujimoto, Y. (2020). Antifungal minor naphthquinone from fungus *Monacrosporium anbrosium* from *Camellia sinensis. Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress.*

3. Liyanaarachchi, C.E., Napagoda,M., Witharana,S., and **Jayasinghe, L.** (2020). Evaluation of Photoprotective Potential of Sunscreen Formulations Prepared from *Leucas Zeylanica* (Gatathumba) Extract. *National Science and Technology Commission, 9th Young Scientists Forum Symposium, Sri Lanka*.

4. *Marasinghe, S.S.K., **Marikkar, J.M.N.,** Wimalasiri, S., **Jayasinghe, L.,** and **Liyanage, R.** (2020). Comparison of Antioxidant Properties of Coconut Testa Flour of Selected Local Coconut Cultivars of Sri Lanka. *MDPI, Proceedings of The Third International Tropical Agriculture Conference.*

5. Nilmini, B.M.S., Kumar, N.S., **Adikaram, N.K.B.,** and **Jayasinghe, L.** (2020). Bioactive extracts from *endophytic fungi* associated with popular antidiabetic medicinal plant *Coccinia grandis,.Postgraduate institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

6. Nilmini, B.M.S., Kumar,N. S, **Adikaram, N.K.B,** and **Jayasinghe, L.** (2020). Screening of alpha-amylase inhibitory activity of endophytic fungal strains associated with Costusspeciosus. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium.*

7. Perera, E.A.I.A., Kumar, N.S., **Adikaram, N.K.B.,**and **Jayasinghe, L.**(2020). Bioactive extracts from an endophytic fungus from *Zingiber officinale*. *Postgraduate institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

8. Perera, E.A.I.A, Kumar, N.S., **Adikaram, N.K.B.,** and **Jayasinghe, L.** (2020). Bioactive extracts from an endophytic fungi from Myristica fragrans. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

Nutritional Biochemistry research project

1. Deen, A., Rizliya, V., Sewwandi, S.M.V.K., Rathnayaka, I., Jayawardana, B.C., and **Liyanage, R.** (2020). Effect of Processing on Bioavailability of Total Phenol, Total Flavanoid and Antioxidant Capacity of Commonly Consumed Legumes in Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Deen, A., Wickramanayake, S., Rizliya, V., Sewwandi, S.M.V.K., Polwattage, A., Rathnayaka, I., Jayawardana, B.C., and **Liyanage, R.** (2020). Effect of simulated digestion using synthetic and natural gastrointestinal enzymes on the total phenol, total flavonoid and antioxidant capacity of commonly consumed raw and boiled legumes in Sri Lanka. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference.*

3. Liyanage, T. P. , Sewwandi, S.M.V.K., Deen, A., Rathnayaka, I., Jayawardana, B.C., and **Liyanage, R.** (2020). Comparison of *in vitro* hydrolysis rates and amylose contents of fifteen commonly available starch sources in Sri Lanka. *University of Ruhuna, Proceedings of 7th Ruhuna Interanational Science & Technology Conference*.

4. *Marasinghe, S.S.K., Marikkar, J.M.N., Wimalasiri, S., **Jayasinghe, L.,** and **Liyanage, R.** (2020). Comparison of Antioxidant Properties of Coconut Testa Flour of Selected Local Coconut Cultivars of Sri Lanka. *MDPI, Proceedings of The Third International Tropical Agriculture Conference.*

5. Sewwandi, S.M.V.K., **Liyanage, R.T.P.,** Deen, A., Rathnayaka, I., Polwattage, A. S., Jayawardana, B.C., and Liyanage, R. (2020). *In vitro* prebiotic activity and dietary fiber content of fifteen different starch sources in Sri Lanka. *University of Ruhuna, Proceedings of 7th Ruhuna Interanational Science & Technology Conference*.

MICROBIOLOGY & CARBON SEQUESTRATION RESEARCH UNIT

Microbial Biotechnology research project

1. Chandralal, R.P.V.T., Jayasekara, A.P.D.A., **Seneviratne, G.,** Herath, H.M.S.K., Silva, P.D.P.M., Abeysinghe, D.C., Premarathna, M. (2020). Effect of biofilm biofertilizer on tea cultivation. *Uva Wellassa University, Proceedings of the International Research Conference of Uva Wellassa University (IRCUWU2020)*.

2. Devika, K.K.C., Singhalage, I.D., **Seneviratne, G.** (2020). Modification of nutrient agar medium to culture un-culturable bacterial strains living in unsanitary landfills. *Uva Wellassa University, Proceedings of the International Research Conference of Uva Wellassa University (IRCUWU2020)*.

3. Ekanayake, S.N.B., **Seneviratne, G.,** Premarathna, M., Gunathilaka, R.P.D., Banagala, C.H.M., Hearth, H.M.S.K. (2020). Potential of biofilm biofertilizer application in paddy soil carbon sequestration in Sri Lanka: an economic feasibility analysis. *Uva Wellassa University, Proceedings of the International Research Conference of Uva Wellassa University (IRCUWU2020)*.

Microbiology & Soil Ecosystems research project

1. Bowange, R.W.T.M.R.T.K., Jayasinghe, M.M.P.M., Yakandawala, D.M.D., Kumara, K.L.W., Abeynayake, S., and **Ratnayake, R.R.** (2020). Morphological Characterization of Cyanobacteria in Extreme Ecosystems of Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Chathuranga, D.M.B.A., Paranavithana, T.M., Gnanavelrajah, N., and **Ratnayake, R.R.** (2020). Spatial Variability of Soil Carbon and Its Relationship with Nutrient Availability in Paddy Soils of Trincomalee District, Sri Lanka. *Faculty of Agriculture, University of Jaffna, 6th International Conference on Dry Zone Agriculture Conference (ICDA 2020)*.

3. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., Kadupitiya, H.K., **Seneweera, S.,** and **Ratnayake, R.R.** (2020). Soil Organic Carbon in Blue Carbon Ecosystems of North West of Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

4. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., Kadupitiya, H.K., **Seneweera, S.** and **Ratnayake, R.R.** (2020). Spatial variation of soil organic carbon fractions in Blue carbon ecosystems at Erukulampiddy, Sri Lanka. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

5. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., **Seneweera, S.,** and **Ratnayake, R.R.** (2020). Effect of salinity in altering microbial biomass carbon at saltmarsh ecosystems at Mannar region, Sri Lanka. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

6. Paranavithana, T.M., Premathilaka, U.L.R.W., Gunathilake, S.K., Karunaratne, S.B., and **Ratnayake, R.R.** (2020). Evaluation of Microbial Biomass Carbon in Paddy Soils of Anuradhapura District, Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

7. Lakmali, H.K.M., Paranavithana,T.M., Perera, G.A.D., and **Ratnayake, R.R.** (2020). Soil carbon sequestration capacity in paddy soils of Kurunegala district, Sri Lanka with respect to its agro climatic regions. *Faculty of Science, University of Kelaniya, Proceedings of International Conference on Applied and Pure Sciences (ICAPS 2020)*.

8. Perera, M. D. R., Paranavithana, T.M., Rizvi, E. M. J. M., Farhath, M.N.M., and **Ratnayake, R.R.** (2020). Soil Organic Carbon Dynamics & Relationships with Nutrient Availability and Physico - chemical Parameters of Paddy Soil in Batticaloa District, Sri Lanka. *9 th Annual Science Research Sessions ASRS 2020 Proceedings of Abstracts of Faculty of Applied Sciences South Eastern University of Sri Lanka*.

EARTH, ENVIRONMENT & BIODIVERSITY RESEARCH UNIT

Earth Resources and Renewable Energy research project

1. Jayathilake, W. M. R. , Dharmapriya, P.L., Lei, Z., Kleinschrodt, R., Kemperle, M., Spiering, B., Abewardana, P., and **Subasinghe, N.D.** (2020). Petrology geochemistry and geochronology of charnockites across the northern highland complex - wanni complex boundary, Sri lanka. *Proceedings of the 36th Technical Session of Geological Society of Sri Lanka*.

2. Jayawardena, S.B.A.D.Y., Jayathilake, H.A.P.P.B., and **Subasinghe, N.D.** (2020). Characteristics of Electrolytic Copper Fractals. *National Institute of Fundamental Studies, Proceedings of the National conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

3. Kumara, K.K.S., and **Subasinghe, N.D.** (2020). Development of a Power-On-Demand Thermoelectric Mobile Phone Charger. *National Institute of Fundamental Studies, Proceedings of the National conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

4. Rathnayake, R.A., Wijekoon, H.S., and **Subasinghe, N.D.** (2020). Analysis of Effective Thermal Conductivity in Suspended and Supported Graphene: Representative Volume Element Approach. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

5. *Wijekoon, H.S., Rathnayake, R.A., **Wijayasinghe, H.W.M.A.C.,** and **Subasinghe, N.D.** (2020). Combined Molecular Dynamics – Representative Volume Element Modeling of Thermal Conduction of Graphene Monolayer Deposited on an Amorphous Silicon Dioxide Substrate. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

Environmental Science Research Programme

1. *Gunarathne, K.M.R.U, **Marikkar, J.M.N., Jayarathna, L.,** Yalegama, L.L.W.C., and Mendis, B.E.P. (2020). Differentiation of coconut testa flour and its lipid component of selected Sri Lankan coconut cultivars by FTIR spectroscopy. *Institute of Chemistry Ceylon, Proceedings of the 1st International Conference on Frontiers in Chemical Technology*.

2. Halpegama, J. U., Nanayakkara, K. G. N., Herath, A. C., Rajapakse, R. M. G., **Weerasooriya, R.** (2020). Fabrication of Reduced Graphene Oxide – nano iron (rGO-nZVI) Anode for Electrocoagulation Treatment to Regulate Excess Fluoride in Water. *Faculty of Science, University of Kelaniya, Proceeding of the International Conference on Applied and Pure Sciences (ICAPS)*.

3. Ranasinghe, M.K.N., **Jayarathna, L.,** Bandara, W.M.A.T. (2020). Hydrothermal Synthesis and Characterization of Mordenite. *Postgraduate Institute of Science, University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

4. Rajapakshe, A.M.D., **Jayarathna, L.,** Bandara W.M.A.T. (2020). Synthesis of Nano Sized CU-Zeolite using a new Microwave Assisted Method. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

5. Senarathna, S.M.D.M.C., Priyankara, T.M.S., and **Bowatte, G.** (2020). Measuring Traffic-Related Air Pollution Using Smart Sensors: Before and During a New Traffic Plan. *Center for Environmental Studies, University of Peradeniya, International conference on Environmental Monitoring and Management*.

6. Senarathna, S.M.D.M.C., Jayaratne, R., Abeysundara, S., Yasaratne, B.M.G.D., Dharmaratne, S.D., **Weerasooriya, R.,** and **Bowatte, G.** (2020). Unexpected air pollution spike in Sri Lanka, November 2019. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

7. Thilakarathne, L.M., Bandara, W.M.A.T., **Jayarathna, L.** (2020). Synthesis of gamma-Ion Oxide Coated Laterite Sand for Adsorptive Removal of Fluoride Ions from Natural Water. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress.*

Evolution, Ecology & Biodiversity research project

1. Ranasinghe, U.G.S.L., Eberle, J., Bohacz, C., **Benjamin, S.P.,** and Ahrens, D. (2020). Patterns of diversity and turnover of pleurostict Sericini chafers (Coleoptera: Scarabaeidae) of Sri Lanka: A preliminary investigation of samples from Knuckles conservation forest. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium.*

2. Satkunanathan, A., Kanesharatnam, N., Athukorala, N., and **Benjamin, S.P.** (2020). A Preliminary Phylogeny and Morphological Analysis of Genus Epidelaxia (Araneae: Salticidae) In Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

3. Tharmarajan, M., Athukorala, N., and **Benjamin, S.P.** (2020). Molecular Phylogeny and Taxonomy of Genera Argyrodes and Rhomphaea (Araneae: Theridiidae) In Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

Plant & Environmental Sciences research project

1. Jayathilake, K.W.D.L., Egodawatta, W.C.P., and **Iqbal, M.C.M.** (2020). Phosphate uptake by flora on Eppawela rock phosphate deposit. 12th Annual Research Symposium Proceedings, faculty of Agriculture, Rajarata University of Sri Lanka.

2. Nilooma, G.H., Ariyaratna, M., and **Iqbal, M.C.M.** (2020). Recovering phosphates from animal farm effluents through phytoremediation: a possible source of bio-phosphorous fertilizer. Proceedings of the Faculty of Agriculture Undergraduate Research Symposium, Peradeniya..

3. *Piyarathne, P. N. M. S, Weerasinghe, L. K, Kumarathunga, D. P, **Wijesundara, D.S.A., Iqbal, M.C.M.,** and Geekiyanage, N. (2020). Leaf photosynthesis and respiration of evergreen woody species in a tropical secondary dry forest: Implications for carbon balance. *Faculty of Agriculture, Rajarata University, 12th Annual Research Symposium*.

Plant Taxonomy & Conservation research project

1. *Piyarathne, P. N. M. S, Weerasinghe, L. K, Kumarathunga, D. P, **Wijesundara, D.S.A., Iqbal, M.C.M.,** and Geekiyanage, N. (2020). Leaf photosynthesis and respiration of evergreen woody species in a tropical secondary dry forest: Implications for carbon balance. *Faculty of Agriculture, Rajarata University, 12th Annual Research Symposium*.

2. Saranasooriya, M. S., Marambe, B., and **Wijesundara, D.S.A.** (2020). Is *Panicum trichocladum* Invasive? *Faculty of Agriculture, University of Peradeniya, Faculty of Agriculture Undergraduate Research Symposium.*

MOLECULAR BIOLOGY & BIOTECHNOLOGY RESEARCH UNIT

Molecular Microbiology & Human Diseases research project

1. De Silva, K.D.H.S.M.S., Senevirathne, M.A.T.M., Wanigatunge, R., Rajapaksha, A.U., **Vithanage, M.,** and **Magana-Arachchi, D.N.** (2020). Preliminary study on cyanobacterial diversity in water sources of CKDu endemic Girandurukotte area, Sri Lanka. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

2. Jayantha, E.G.J., Jayasuriya, W.J.A.B.N., Herath, H.M.D.R., Suresh, T.S., Madamarandawala, J.M.P.S., and **Magana-Arachchi, D.N.** (2020). Anti-tuberculosis activity of selected medicinal plants and Pleurotus mushrooms. *Sri Lanka Association for Laboratory Animal Science (SLALAS) Seventh Annual Scientific Sessions and International Conference 2019/2020*.

3. Madamarandawala, J.M.P.S., Rajapakse, R.G.S.C., Madegedara, R.M.D., and **Magana-Arachchi, D.N.** (2020). Prevalence of drug resistance among Tuberculosis patients in Kandy, Sri Lanka and associated factors. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

4. Samarasinghe, D.G.S.N., Wanigatunge, R., and **Magana-Arachchi, D.N.** (2020). Diversity of Firmicutes bacterial communities in selected hot water springs of Sri Lanka by 16S metagenomic sequencing. *Faculty of Science, University of Kelaniya, Proceedings of International Conference on Applied and Pure Sciences ICAPS 2020*.

5. Samarasinghe, D.G.S.N., Wanigatunge, R., and **Magana-Arachchi, D.N.** (2020). Diversity of phylum Proteobacteria in four hot springs of Sri Lanka based on 16S rRNA metagenomic analysis. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

6. Thilakarathne, S.M.N.K., Ekanayake, E.M.U.A., Madamarandawala, J.M.P.S., Weerarathne, W.B.C.P., and **Magana-Arachchi, D.N.** (2020). Fluctuations of airborne bacterial community in November 2019 haze event, Kandy Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, 2nd International conference of Environmental Monitoring and Management - EMM2020*.

7. Thilakarathne, S.M.N.K., Samarasinghe, D.G.S.N., Wanigatunge, R., and **Magana-Arachchi, D.N.** (2020). Stenotrophomonas maltophilia, a potential multidrug-resistant pathogen in Sri Lankan hot water springs. *Microbial Ecology Network, Nepal, Southeast Asian Regional Symposium on Microbial Ecology (SARSME -2020)*.

8. Weerarathne, W.B.C.P., **Vithanage, M., Wijayasinghe, H.W.M.A.C.,** Madegedara, R.M.D., and **Magana-Arachchi, D.N.** (2020). An insight into chemical and physical properties of atmospheric depositions in an asbestos roofing factory in Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, 2nd International conference of Environmental Monitoring and Management - EMM2020*.

9. *Weerarathne, W.B.C.P., **Vithanage, M., Wijayasinghe, A.C.,** and **Magana-Arachchi, D.N.** (2020). Particulate matter analysis in air of a high-density Chrysotile asbestos related production factory in Sir Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgraduate Institute of Science Research Congress*.

Plant Stress Biology & Molecular Genetics research project

1. Cabral de Mel, de Mel, R.K., Senanayake, M.H., Bandaranayake, R., **Seneweera, S.,** Dangolla, A., Weerakoon, D.K., Maraseni, T., and Allen, B.L. (2020). Responses of Asian elephants (Elephas maximus) to an electronic training collar. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

2. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., Kadupitiya, H.K., **Seneweera, S.,** and **Ratnayake, R.R.** (2020). Soil Organic Carbon in Blue Carbon Ecosystems of North West of Sri Lanka. *Postgraduate Institute of Science, University of Peradeniya, Sri Lanka, Proceedings of the Postgradu-*

ate Institute of Science Research Congress.

3. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., Kadupitiya, H.K., **Seneweera, S.** and **Ratnayake, R.R.** (2020). Spatial variation of soil organic carbon fractions in Blue carbon ecosystems at Erukulampiddy, Sri Lanka. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

4. *Dissanayake, D.D.M.O., Jayasinghe, J.A.V.R., Perera, G.A.D., **Seneweera, S.,** and **Ratnayake, R.R.** (2020). Effect of salinity in altering microbial biomass carbon at saltmarsh ecosystems at Mannar region, Sri Lanka. *University of Ruhuna, Proceedings of 7th Ruhuna International Science & Technology Conference*.

5. Kamaral, L.C.J., Neate, S., Paterson, D.J., Kopittke, P.M., Rajaratne, T.M., and **Seneweera, S.** (2020). Fine mapping of grain zinc using synchrotron-based XFM revealed genetic variation in grain Zn distribution in wheat cultivars. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

6. Manawasinghe, K.S., Chandrajith, R., and **Seneweera, S.** (2020). Altering of plant growth and physiology of rice (*Oryza sativa L*.) at vegetative stage under elevated arsenic in soil. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

7. Samarasinghe, C.H., Hassan, Z, Rajaratne, T.M., Kamaral, L. C. J, and **Seneweera, S.** (2020). Nutrient partitioning of wheat (*Triticum aestivum L.)* grain is influenced by elevated CO_2 and heat stress. *National Institute of Fundamental Studies, Proceedings of the National Conference on Multidisciplinary Research 2020, Virtual postgraduate symposium*.

BOOKS & BOOK CHAPTERS

Books Chapters

1. Jayalal, U., Weerakoon, G., Wolseley, P., **Wijesundara, D.S.A.,** and Karunaratne, V. (2020). A Provisional List of Lichens in Sri Lanka. *The National Red List 2020 - Conservation Status of the Flora of Sri Lanka.* (p. 214-225). Colombo, Biodiversity Secretariat of the Ministry of Environment and the National Herbarium, Department of the National Botanic Gardens, Peradeniya.

2. Jayasekara, S.K., Kathirgamanathan, M., and **Ratnayake, R.R.** (2020). Isolation, Identification and Study of the Potential Applications of Tropical Fungi in Lignocellulolysis.. *Research Advances in the Fungal World: Culture, Isolation, Identification, Classification, Characterization, Properties and Kinetics.* (p. 35-59). New York, USA, Nova science publishers, inc.

3. Jayasinghe,G. G., Rajapakse,R. H. S., Wasantha Kumara,K. L., Ratnasekera,D., and **Adikaram, N.K.B.** (2020). Pests and Diseases of Cinnamon (Cinnamomum zeylanicum Blume). *Cinnamon Botany, Agronomy, Chemistry and Industrial Applications.* (p. 201-232). Switzerland, Springer Nature.

4. **Magana-Arachchi, D.N.,** and Wanigatunge, R. (2020). Ubiquitous waterborne pathogens. *Waterborne Pathogens, Detection and Treatment* (p. 15-42). , Elsevier Butterworth-Heinemann.

5. Medawatte, W.W.M.A.B, Ranwala, S.M.W., Brearley, F.Q., and **Iqbal, M.C.M.** (2020). Dry forest degradation and traditional land-use in the context of sustainable forest management in Sri Lanka. *Tropical Dry Forests: Emerging Features and Future Perspectives* (p. 1-37). Hauppauge, Nova Science Publishers.

6. Ranil, R. H. G., Gunawardena, N. P. T., Muthukuda Arachchi, D. K. T., Pushpakumara, D. K. N. G., and **Wijesundara, D.S.A.** (2020). Pteridophytes in Sri Lanka. *The National Red List 2020 - Conservation Status of the Flora of Sri Lanka.* (p. 170-189). Colombo, Biodiversity Secretariat of the Ministry of Environment and the National Herbarium, Department of the National Botanic Gardens, Peradeniya.

7. **Wijesundara, D.S.A.,** Ranasinghe, S., Jayasinghe, H., Gunawardena, N., Fonseka, G., and Wijesooriya, S. (2020). Angiosperms in Sri Lanka - Present status of Angiosperms in Sri Lanka.. *The National Red List 2020 - Conservation Status of the Flora of Sri Lanka.* (p. 1-7). Colombo, Biodiversity Secretariat of the Ministry of Environment and the National Herbarium, Department of the National Botanic Gardens, Peradeniya.

Grants

PI: Principle Investigator, CL: Collaborator

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2020-12-01 to 2025-12-01	**Wijesundara, D.S.A.**	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. R. Jayawaradana (CL), and **Dr. R. Liyanage** (CL)	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** (CL) and Prof. D. Yakandawala (CL)	A study of postharvest disorders, pitting in guava, mango & papaya & husk scalding, pulp spot, chilling injury & vascular browning in avocado & their manage	Research Grant form National Research Council	4,983,600
2020-11-17 to 2023-11-17	Dr. G.D.R.K. Perera(PI), Dr. H.M.S. Wasana(CL), Dr. H.T.K. Abeysundara(CL), and **Dr. L. Jayarathna** (CL)	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 Jafna	1,600,000
2020-07-24	**Prof. S.A. Kusasooriya**	To purchase Fabrication and installation of two Bioreactors	Instrument Grant from National Science Foundation	800,000
2020-05-21 to 2020-05-31	**Prof. S Seneweera,** and **Dr. G.R.A. Kamra, A**	To develop a prototype low-cost sodium hypochlorite generator	Research Grant from Ministry of Higher Education, Technology and Innovation	90,000
2020-04-01 to 2021-03-31	**Prof. S. Seneweera** (PI) and **Dr. L. Jayarathna**	Development of rapid test kits for Covid –19	Research Grant from Ministry of Technology and Research	3,900,000
2020-01-01 To 2020-12-31	**Prof. G. Seneviratne (**PI), and **Prof. S.A. Kulasooriya** (CL)	Microbial Biofertilizers for releasing chemical fertilizers in Agriculture	Research Grant by Ministry of Research & Innovation	6,600,000

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2019-12-09 to 2020-02-21	**Prof. S. Seneweera** (PI), and C. Kamral (CL)	Use of the X-ray fluorescence microscopy beamline at the Australian Synchrotron	Research Grant from Australian Nuclear Science and Technology Organization (ANSTO Australia)	12,000,000
2019-10-03 to 2022-10-03	Dr. P.L. Dharmapriya (PI) **Prof. D. Subasinghe, N.D. (CL),** Prof. S. Malaviarachchi, and Prof. H.M.T.G.A. Pitawala	For ER&RE, NIFS	Research Grant from National Research Council	4,000,000
2019-10-30 to 2022-10-30	**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	Dr. P.L Dharamapriya(PI), **Prof. N.D. Subasinghe**(CL)	Petrogenesis, geochemistry and potential of economic mineralization of granitic pegmatite in Sri Lanka	Research Grant from National Research Council	2,500,000
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(CL**)	Engineering nanomaterials for photovoltaic and environmental remedial applications	Research Grant by Ministry of Higher Education, & World Bank	30,000,000
2019-07-12 to 2022-07-12	**Prof. S. Seneweera (PI)**, Dr B. Allen (CL),Prof. D.K. Weerakoon (CL), 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**(CL), and Prof. A. Bandra(CL)	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	**Wijayasinghe, H.W.M.A.C.** (CI) received a on 2019-06-01 for (Grant Value - LKR)	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**(CL)**,** and Prof. T. Schaefer (CL)	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** (CL), Dr. Wanigatunge (CL), and Dr.A.U. Rajapaksha, (CL)	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 2021-12--23	**Prof. D.N. Magana-Arachchi**	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.** (Pl), Prof. N.S. Kumar (CL), **Prof. N.K.B. Adikaram**(CL), and Dr. N.R. Amarasinghe (CL)	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 (CL), Dr. L. Knibbs (CL), **Prof. R. Weerasooriya** (CL), and Dr. S. Dharmage (CL)	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
2018-09-15 to 2020-09-15	**Prof. N. Adikaram** (PI)., **Prof. L. Jayasinghe** (CL) and Prof. D. Yakandawala (CL)	Study of some postharvest diseases and disorders adversely affecting the export potential of mango variety TomEJC and their management	Research Grant from National Research Council	3,642,222

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
2018-05-30 to 2020-05-30	**Prof. D.N. Magana-Arachchi** (CL), **Prof. M. Vithanage** (CL) and Prof. C. Wickramasinghe(PI)	Ballon 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	Research Grant from The Bjornson and Prodan Foundation	1,957,956
2018-05-10 to 2020-05-10	**Prof. R. Ratnayake**	Development of baseline soil information system for soil C and other nutrients for paddy growing soils in Sri Lanka	Research Grant from National Research Council	4,695,723
2018-05-15 to 2020-05-15	**Pro. L. Jayasinghe**(PI), Prof. N.S. Kumar (CL) and **Prof. N. Adikaram** CL)	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 Counsil	4,629,302
2018-04-30 to 2021-04-30	**Prof. J. Bandara**	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

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2018-04-20 to 2021-04-20	**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**(CL), Prof N.S. Kumar (PI), **Prof. N. Adikaram** (CL), and Dr. N.R. Amarasinghe (CL)	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
2018-02-15 to 2020-02-15	Mr. T. Jaseetharan (supervised by **Prof. M.A.K.L. Dissanayake** and **Prof. G.K.R. Senadeera**)	For Postgraduate research	Research Grant from National Science Foundation	860,000
2018-01-01 to 2020-12-31	**Prof. M.A.K.L. Dissanayake(PI),** and **Prof. G.K.R. Senadeera (CL)**	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. H.W.M.A.C. Wijayasinghe** (PI)	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, (PI), and **Prof. L. Jayasinghe** (CL)	Development of effective sunscreen formulations from Sri Lankan medicinal plants	Research Grant from National Science Foundation	3,890,656
2017-11-25 to 2020-11-25	**Prof. N.D. Subasinghe, N.D**.(PI), Dr. S. Malaviarachchi (CL) and Dr. P.L. Dharmapriya (CL)	ER&RE, NIFS	Research Grant from Ministry of Science, Technology & Research - (Indo-Lanka Grant)	12,000,000

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2017-08-31 to 2020-08-31	**Prof. S.P. Benjamin**	Taxonomic revisions of jumping spider subfamilies Ballinae and Spartaeinae of Sri Lanka based on morphology and DNA barcodes	Research Grant from National Research Council	4,969,600
2017-01-01 to 2021-01-01	**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** (CL) Dr. A Bandara, Prof. A.K. Kumarasiri, Prof. Ajith Herath	Development a model treatment facility for remediation of total dissolved solids and fluoride in groundwater	Research Grant from National Research Council	50,000,000
2016-10-25 to 2020-02-01	**Prof. D.S.A. Wijesundara**	For Floristic Survey of NIFS-Popham Arboretum, Dambulla	Research Grant from Biodiversity secretariat, Ministry of Mahaweli Development and Environment	334,925
2016-06-02 to 2020-05-03	**Prof. D.S.A. Wijesundara**	For *Panicum trichocladum* Project	Research Grant from Biodiversity secretariat, Ministry of Mahaweli Development and Environment	440,000
2014-09-01 to 2020-08-31	Dr. S.P.K. Malaviarachchi (PI), **Prof. N.D. Subasinghe** (CL), Dr. P.L. Dharamapriya.(CL)	Probing the provenance and distribution of heavy – mineral placer deposits in coastal areas of Southern India and SW Sri	Research Grant from Ministry of Science, Technology and Research	4,000,000

Research Collaborations

ENERGY & ADVANCED MATERIAL RESEARCH UNIT

Research Project	Collaborator & Institute	Summary	Duration
Condensed Matter Physics and Solid State Chemistry **Prof. M.A.K.L. Dissanayake**	Prof. B-E. Mellander Chalmers University (Sweden)	Dye sensitized solar cells and Quantam dot sensitized solar cells.	2019-01-01 to 2022-12-31
	Mr. 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
	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 2021-12-31
	Dr. H.N.M. Sarangika Sabaragamuwa University of Sri Lanka	Applications of TiO_2.	2018-01-01 to 2021-12-31
	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 2021-12-31
	Dr. T.M.W.J. Bandara Department of Physics, University of Peradeniya	Dye sensitized solar cells.	2018-01-01 to 2021-12-31
	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 2021-12-31
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

Research Project	Collaborator & Institute	Summary	Duration
(continued from previous page..)			
Material Processing and Device Fabrication **Prof. G.R.A. Kumara**	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
	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 **Dr. H.W.M.A.C. Wijayasinghe**	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 & FOOD CHEMISTRY RESEARCH UNIT

Research Project	Collaborator & Institute	Summary	Duration
Food Chemistry **Prof. J.M.N. Marikkar**	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 base material for value addition. Owing to 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
	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 2020-12-01
	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
Natural Products **Prof. L. Jayasinghe**	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

Research Project	Collaborator & Institute	Summary	Duration
Natural Products **Prof. N.K.B. Adikaram**	University of Peradeniya	Molecular identification of fungi isolated from diseases of mango varieties TomEJC.	2017-11-01 to 2021-01-01.
Nutritional Biochemistry **Dr. R. Liyanage**	Prof. Barana Jayawardana Faculty of Agriculture, University of Peradeniya	This study focuses on the bioavailability of pro-nutritive and anti-nutritive factors in legumes after in vitro digestion and fermentation. Findings of this study will be useful in determining potential uses of these legumes in food formulation.	2018-06-06 to 2020-12-12
	Dr.Srinivas Nammi Western Sydney University , Australia	This study investigates the antidiabetic, antinflammatory and anticancer properties of some selected Ayurvedic plants in Sri Lanka.	2017-01-05 to 2020-12-31

MICROBIOLOGY & CARBON SEQUESTRATION RESEARCH UNIT

Research Project	Collaborator & Institute	Summary	Duration
Microbial Biotechnology **Prof. G. Seneviratne**	Department of Agriculture	We collaborate with department of Agriculture for island wide testing of efficacy of Biofilm Biofertilizer in rice cultivation.	2019-10-01 to 2020-10-01
Microbiology and Soil Ecosystems **Prof. R.R. Ratnayake**	Dr. H.K. Kadupitiya Natural Resource Management Center	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
	Prof. K.L.W. Kumara 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. 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 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

EARTH, ENVIRONMENT & BIODIVERSITY RESEARCH UNIT

Research Project	Collaborator & Institute	Summary	Duration
Earth Resources and Renewable Energy **Prof. N.D. Subasinghe**	Prof. M. Eswaramoorthy Shri Mata Vaishno Devi University	Hybrid Solar Thermoelectric Generator	2019-01-01 to 2021-12-31
	Dr. Sanjeewa Malaviarachchi Dr. P.L. Dharmapriya Department of Geology, University of Peradeniya	Petrology and Mineralogy project	2015-06-01 to 2020-12-31
	Mr. Prasad Mahakumara, Sri Lanka Atomic Energy Board	Radon Mapping program.	2015-06-01 to 2020-12-31
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
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	This project aims to 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
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
	Prof. N. Rajakaruna Plant Biology, Biological Sciences Department, California Polytechnic State University, San Luis Obispo	This collaboration investigates all the serpentine sites in Sri Lanka to study the soil-plant ecology of the serpentine sites.	2017-07-01 to 2020-06-01

Research Project	Collaborator & Institute	Summary	Duration
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Plant and Environmental Sciences **Prof. M.C.M. Iqbal**	Dr. C. Mollers Georg-August-Universität Göttingen, Department of Crop Science, Von Siebold Str. 8, 37075 Göttingen, Germany	Androgenesis in Brassica. The NLN-medium has been successfully used, since 1982, for microspore culture in *Brassica napus* and other Brassica species. Changes to the media composition were restricted to carbohydrate and nitrogen sources and growth regulators while micro-nutrients have not been optimized. Boron is required for diverse physiological and metabolic processes in the cell. This study would investigate the effect of seven- and 13-fold increased boron concentration on the induction of embryos in microspore cultures of four genotypes of *B. napus.*	2016-08-01 to 2020-08-01
Plant Taxonomy and Conservation **Prof. D.S.A. Wijesundara**	Dr. Subhhani Ranasnghe, and Mr. Himesh D. Jayasinghe (M.Phil. Student) National Herbarium, Peradeniya	Taxonomic treatment of genus Syzygium in Sri Lanka.	2018-12-03 to 2020-12-03
	Prof. Sumedha Madawala, and Mr. Tharanga Wijewickrama (Ph.D. Student) Department of Botany, Faculty of Science, University of Peradeniya	Impact of Bambusa bambos on native ecosystems in Moragahakande.	2018-09-17 to 2020-09-17
	Prof. B.M.R. Bandara, and Ms. Eishani Samarasinghe (Ph.D. Student) Department of Chemistry, Faculty of Science, University of Peradeniya	Antifungal and anti-insecticidal plants from Invasive plants.	2018-09-01 to 2020-09-01
	Prof. Kapila Yakandawala , Dr. Sewwandi Jayakjody, and Mr. Samantha Gunasekera (M.Phil. Student) University of Vayamba (Department of Horticulture & Landscape Gardening), (Department of Aquaculture and Fisheries)	Geographical distribution & genetic diversity of Vanda tessellata (Roxb) Hook.f. ex G.Don in Sri Lanka..	2018-04-01 to 2020-04-01

Research Project	Collaborator & Institute	Summary	Duration
(continued from previous page..)			
Plant Taxonomy and Conservation **Prof. D.S.A. Wijesundara**	Prof. Lalit Kumar, and Ms. Champika Kariyawasam (Ph.D. Sudent) University of New England, Australia (School of Environmental and Rural Science)	Potential distribution of invasive plants in Sri Lanka and impacts on biodiversity under climate change	2018-03-27 to 2020-03-27
	Dr. P.Bandaranayake, and Ms. N. Rajapakshe (M.Phil. Student) Biotechnology Center, Faculty of Agriculture, University of Peradeniya	Genus Strobilanthes in Sri Lanka.	2018-01-15 to 2020-01-15
Primate Biology **Prof. W. Dittus**	Indian Institute of Science **Prof. Suresh P. Benjamin,** Prof. Karanth	investigate the genetic consequences and underpinnings of the hybridization events among Sri Lankan langurs. The research involves 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 2021-10-31

MOLECULAR BIOLOGY & BIOTECHNOLOGY RESEARCH UNIT

Research Project	Collaborator & Institute	Summary	Duration
Molecular Microbiology and Human Diseases **Prof. D.N. Magana-Arachchi**	Prof. Chandra Wickramasinghe Buckingham Centre for Astrobiology, Buckingham, UK, and Centre for Astrobiology,	The aim is to launch specially designed devices using balloons to collect samples of stratospheric air from heights between 30 and 50 km, recover the samples safely, and to analyse their bacterial content. The proposed work is of crucial importance in the validation of the Hoyle-Wickramasinghe theory of cometary panspermia, the evidence for which appears to be rapidly growing at the present time.	2018-05-31 to 2020-05-31

Research Project	Collaborator & Institute	Summary	Duration
(continued from previous page..)			
Molecular Microbiology and Human Diseases **Prof. D.N. Maganaarachchi**	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 2021-04-20
	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 patient status and reduce the overall health care cost spent on tuberculosis in Sri Lanka.	2018-04-20 to 2021-04-20
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 2023-12-12
	Professor Stephen Neate University of Southern Queensland Australia	Rice and wheat biofortification.	2014-01-01 to 2021-01-01
	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 2022-09-22
	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 2022-06-03

Research Project	Collaborator & Institute	Summary	Duration
(continued from previous page..)			
Plant Stress Biology & Molecular Genetics **Prof. S. Seneweera**	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 2024-01-20

RESEARCH SUPERVISION 2020

A.1 Post graduate degrees completed in year 2020

- **Ms. M. Aryal**
  Supervisors: **Prof. S. Seneweera,** Dr. L. Kouadio, Dr. K.B. Dassanayake
  Thesis title
  Modelling Rice and Wheat Response to Rising Carbon Dioxide Concentration
  Ph.D degree, awarded by University of southern Queensland

- **Mr. D.M.R.E.A. Dissanayake**
  Supervisors: **Prof. M.C.M. Iqbal,** Prof. S.S. Iqbal, and Prof. N. Priyantha
  Thesis title
  Development of adsorbents for heavy metal and dye contaminated wastewater treatment.
  Ph.D degree, awarded by Postgraduate Institute of Science, University of Peradeniya

- **Mr. P. Dehigaspitiya**
  Supervisors: **Prof. S. Seneweera,** Prof. A. Gavin, Dr. A. Martin, Dr. S. A. Kiruba
  Thesis title
  Site specific photosynthesis in wheat (*Triticun aestivum L.)*
  Ph.D degree, awarded by University of southern Queensland

- **Mr. I. Herath**
  Supervisors: **Prof. S. Seneweera,**
  Thesis title
  Environmental Engineering and Technology
  Ph.D degree, awarded by University of southern Queensland

- **Mr. T. Jaseetharan**
  Supervisors: **Prof. M.A.K.L. Dissanayake,** and **Prof. G.K.R. Senadeera**
  Thesis title
  Synthesis and characterization of Cadmium Sulphide and Lead Sulphide semiconductor quantum dots and their applications in solar cells and infrared detectors
  Ph.D degree, awarded by Postgraduate Institute of Science, University of Peradeniya

- **Ms. S. Selvaskanthan**
  Supervisors: Prof. J.P. Eswara, **Prof. L. Jayasinghe,** and Prof. D.K.N.G. Pushpakumara
  Thesis Title
  Micropropergation and production of Agarwood fragrance compound by plant cell cultures of Gyrinops walla
  Ph.D. degree, awarded by postgraduate Institute of Agriculture, University of Peradeniya.

- **Mr. H.M.D.A.H. Bandara**
  Supervisors: **Prof. N.D. Subasinghe** Dr. S.P.K. Malaviarachchi
  Thesis Title
  Geophysical and Petrological Investigations of the thermal springs in Sri Lanka with special emphasis on the Highland – Vijayan tectonic boundary".
  M.Phil degree, awarded to by University of Peradeniya

- **Ms. D.P. Bopearachchi**
  Supervisors: **Prof. S.P. Benjamin,** and Prof. W.A.P. Karunaratne
  Thesis title
  Molecular Phylogeny and Systematics of three jumping spider tribes (Araneae: Salticidae) of Sri Lanka
  M.Phil degree, awarded to by University of Peradeniya

- **Miss. S.K.Jayasekara**
  Supervisor: **Prof. R.R. Ratnayake**
  Thesis title
  Microbial cellulases:The potential application in biofuel production, textile industry and agriculture
  M.Phil degree , awarded by University of Peradeniya

- **Ms. P.M.H. Sandamali**
  Supervisors: Prof. S.P. Senanayake, Prof. S. Rajapakse, and **Prof. S.P. Benjamin**
  Thesis title
  Systematics of Genera Dedrobium Swartz and Bulbophyllum Thouars (Family: Orchidaceae) in Sri Lanka"
  M.Phil degree , awarded by University of Peradeniya

- **Ms. W.A.D.D Wasalamuni**
  Supervisor: **Prof. R.R. Ratnayake**
  Thesis titled
  Soil carbon sequestration potential of home global warming
  M.Phil degree, awarded by University of Peradeniya

- **Ms. W.A.P.M.M. Ariyarathna**
  Supervisors: Prof. T. Madujith, and **Prof. R. Liyanage**
  Thesis title
  In vitro screening of Sri Lankan Ayurvedic plants for their antioxidant activity
  M.Sc. degree , awarded by University of Peradeniya

- **Ms. H.A.H. Hiroshini**
  Supervisor: **Prof. D.N. Magana-Arachchi**
  Thesis title
  Potential of extracellular hydrolytic enzyme production in halophilic bacteria identified from Ussangoda coast, Sri Lanka
  M.Sc. degree , awarded by University of Kelaniya

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 photovolta-ics	Research Assistant/ Grant

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
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	Research Assistant/ NIFS
Prof. L. Jayasinghe, and Prof. N. Kuhnert	Ms. A.G.A.W Alakolanga	Natural Products and Bio-chemistry	External/ Uwa Wel-lasa University
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Ms. K.D.M.S.P.K. Kumara-singhe	Solar Energy Materials	Research Assistant/ NIFS
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. J. Bundschuh, **Prof. S. Seneweera, ,** Prof. A. Meharg, and Prof. Y. S. Ok	Mr. P. Kumarathilaka	Environmental Science ***(Thesis Submitted)***	External
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 Nanotech-nology	External
Prof. N.D. Subasinghe	Mr. N.B. Suriyaarachchi	Geophysics	External
Dr. H.W.M.A.C. Wijaya-singhe	Mr. W.T.R.S. Fernando	Cathode Development for Rechargeable Batteries	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	Ms. C. P. Amarasinghe	Plant Pathology	Research Assistant/ NIFS
Prof. N.K.B. Adikaram, Prof. L. Jayasinghe, and Prof. D. Yakandawala	Mrs. L. N. Manawadu	Post-Harvest Pathology	Research Assistant/ NIFS
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	Research Assistant/ NIFS
Prof. S.P. Benjamin	Ms. M. Tharmarajan	Molecular Systematics	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. S. Senthuran	Dye sensitized solar cells	Research Assistant/ Grant
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	Research Assistant/ Grant
Prof. L. Jayasinghe, Prof. N. S. Kumar, and **Prof. N. K. B. Adikaram**	Ms. H. S. T. Kaushalya	Natural Product Chemistry	Research Assistant/ NIFS
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	Research Assistant/ Grant

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
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/ NIFS
Prof. G.R.A. Kumara, and Prof. P.M. Sirimanne	Mr. P.N. Dissanayake	Photo chemistry	Research Assistant/ NIFS
Prof. D.N. Magana-Arachchi, and Prof. N.V. Chandrasekharan	Ms. E.M.U.A. Ekanayake	Study of lung micro-biota in lung cancer and bronchiectasis patients ***(Thesis submitted)***	Research Assistant/ Grant
Prof. D.N. Magana-Arachchi, Prof. R.G.S.C. Rajapakse, and Dr. R.M.D. Madegedara	Ms. J.M.P.S. Madamarand-awala	drug-resistant tuber-culo	Research Assistant/ Grant-NSF
Prof. D.N. Magana-Arachchi, and Dr. R. Wanigatunge	Ms. D.G.S.N. Samarasinghe	Molecular Microbiology	Research Assistant/ Grant-NSF
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 uri-nary biomarkers for CKD	External
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	Research Assistant/ NIFS
Dr. R. Liyanage, Prof. L. Jaya-singhe and Prof. B.C. Jaya-wardana	Ms. F.A. Deen	Food Science & Technology	Research Assistant/ NIFS
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 Biochem-istry	Research Assistant/ NIFS
Prof. R.R. Ratnayake	Ms. T.M. Paranavithana	Soil Carbon seques-tration	Research Assistant/ NIFS
Prof. R.R. Ratnayake, and **Prof. S. Seneweera**	Ms. D.D.M.O. Dissanayake	Soil Carbon seques-tration	Research Assistant/ NIFS

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
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. C. Perera, Dr. D. Gamage, and Prof. H. Naoki	Ms. N.D.U.S. Nakandala	Plant Molecular Biology and Physiology	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, 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 Prof. H.M.T.G.A. Pitawala	Mr. D.R. Charles	Geophysics & Geology ***(Thesis submitted)***	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
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	Research Assistant/ Grant

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
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
Dr. H.W.M.A.C. Wijayasinghe, Dr. N.W.B. Balasooriya, and Prof. H.M.T.G.A. Pitawala	Ms. T.C. Senevirathna	Development of local graphite for lithium-ion batteries	Research Assistant/ Grant-NRC
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
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 MSc research projects in progress

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. N.K.B. Adikaram, and Prof. D. Yakandawala	W. M. S. Kurera	Molecular Biology and Biotechnology	External
Prof. J. Bandara	Ms. M.C.M. Rajapaksha	Photocatalyst	Research Assistant/ Grant
Prof. J. Bandara	Mr. S.A.D.A.V. Sumithraarachchi	Water Purification	Research Assistant/ Grant
Prof. M.A.K.L. Dissanayake, and **Prof. G.K.R. Senadeera**	Ms. Imali Madigasekara	Plasmonic HgS heterojunction solar cells	External
Prof. M.A.K.L. Dissanayake, Prof. G.K.R. Senadeera, and Dr. B.S. Dassanayake	Mr. H.K. Hiran Dananjaya Kankanamge	Plasmonic Dye Sensitized solar cells	External
Prof. M.C.M. Iqbal, and Dr. C.S. Kalpage	Ms. R.G.C.P. Rajapaksha	Environmental Science	External
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Mr. D.A.N.C. Abeysekara	Nanoscience and nanotechnology	External
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Mr. N.M. Keppetipola	Dye-sensitized Solar Cells	External

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Dr. R. Liyanage and Prof. R. Sivakanesan	Ms. R.J. Bangamuwage	Some Physio-chemical Properties of Starches from Fifteen Different Botanical Sources ***(Thesis submitted)***	External
Dr. B. Jayasooriya, and **Prof. D.N. Magana-Arachchi**	Ms. E.G.J. Jayantha	Pharmacognacy	External
Prof. N.D. Subasinghe	Ms. S.B.A.D.Y. Jayawar-dena	River networks	External
Prof. R. Weerasooriya	Ms. H.M.D.K.Y. Heenkenda	Computational Science	External
Prof. R. Weerasooriya	Ms. G.G.D.P. Jayaward-hene	Water purification	External

B.1 Undergraduate research projects completed

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. M.A.K.L. Dissanayake	Cuprous oxide based Dye Sensitized Solar cell	Ms. Ivani Jayalath University of Sri Jayawardenepura
Prof. M.A.K.L. Dissanayake	Interfacial Properties of n- Copper(I) oxide / p- Copper(I) Iodide Hetero-junction	Ms. I.W. Ridmi Nisansi University of Sri Jayawardenepura
Dr. L. Jayarathna	Synthesis, Characterization and Determination of catalytic activity of Iron and copper modified zeolites	Ms. P. S. Dias University of Peradeniya
Dr. L. Jayarathna	Hydrothermal synthesis, characterization and determination of catalytic activity of Mordenite	Ms. M. K. N. Ranasinghe University of Peradeniya
Dr. L. Jayarathna	Gamma Iron oxide coated Laterite sand for adsorptive removal of Fluoride from natural water"	Ms. L. Thilakarathne University of Peradeniya
Mrs.C.P.Rupasinghe, **Prof. L. Jayasinghe,** and **Prof. S. Seneweera**	Identification of bioactivity of stem bark of Vateria copallifera	Ms.J.C.Weerasinghe University of Ruhuna
Prof. G.R.A. Kumara, Dr. T.M.W.J. Bandara, and Prof. P. Samareasekara	Separation of Agar Based Jell Polymer Electrolyte and Preparation of Fluorine-doped Tin Oxide (FTO) Films on Sodalime Glass by Atomized Spray Pyrolysis	Ms. A.A.A.P. Aththanayake University of Peradeniya
Prof. J.M.N. Marikkar	Bioactivity Studies of Different Solvent Extracts Obtained from Coconut Testa Flour of Five Local Coconut Cultivars	Ms. A. J. Fathima Musny Sabaragamuwa University of Sri Lanka
Dr. R. Liyanage, and Dr. N. S. Weerakkody	Evaluation of antioxidant activity of rice grown with biofilm biofertilizer	Ms. B.H.S.M.Bopagoda The Open University of Sri Lanka
Dr. R. Liyanage, and Ms. S. Gamage	Production of natural high fiber drink using mango, pineapple, golden apple, and dates	Ms. M. K. Jayaweera Nilai University, Malaysia (Horizon Campus)
Dr. R. Liyanage, and Ms. S. Gamage	Development of spices incorporated osmotically dehydrated fruits	Ms. P. Costa Nilai University, Malaysia (Horizon Campus)

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. R.R. Ratnayake	Soil Carbon Sequestration and Nutrients Retention Capacity in Paddy fields of Kurunegala District, SriLanka with respect to its Major Climatic Conditions	Ms. H.K.M. Lakmali University of Peradeniya
Prof. R.R. Ratnayake	Determination of soil organic carbon status and its relationships with nutrient availability and physico-chemical parameters of paddy soils in Batticaloe District, Sri Lanka	Ms. M.D.R. Perera South Eastern University of Sri Lanka
Prof. R.R. Ratnayake	Spatial variability of soil carbon and its relationships with in paddy soils of Trincomalee District, Sri Lanka	Mr. D.M.B.A. Chathuranga University of Jaffna
Prof. R.R. Ratnayake	Estimation of soil carbon contents with regard to physico-chemical parameters of paddy soils in Ampara District, Sri Lanka	Mr. R.H.S.P. Wishvajith South Eastern University of Sri Lanka
Prof. R. Weerasooriya	Determination chemical evaluation of ground water of 1-D of solute transport modeling	Ms. S. Dayarathna University of Peradeniya

B.2 Undergraduate research projects in progress

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. M.A.K.L. Dissanayake, Prof. G.K.R. Senadeera, and Dr. H.N.M. Sarangika	Electrolytes for batteries	Mr. H.T.G. Shashintha University of Sabaragamuwa
Prof. M.A.K.L. Dissanayake, and **Prof. G.K.R. Senadeera**	Solar Cells	Mr. T. Liyanage University of Peradeniya
Prof. M.C.M. Iqbal	Salvinia as a Phosphate fertilizer	Ms. G.H. Nilooma University of Peradeniya
Prof. M.C.M. Iqbal	Environmental Science	Ms. K.T.S. Nirmanee Faculty of Agriculture, Rajarata University of Sri Lanka
Prof. M.C.M. Iqbal, and Egodawatta, W.C.P	Undergraduate student of is conducting the research project in the research area of "Phosphate uptake by flora on Eppawala Rock phosphate deposit	K.W.D.L Jayathilake Rajarata University of Sri Lanka

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. D. S. Rajapakshe University of Peradeniya
Dr. L. Jayarathna	Material Science	Mr. R. M. K. A. Rathnayake University of Peradeniya
Dr. L. Jayarathna	Water Purification	Miss. W. A. D. K. Senevinanda, University of Peradeniya
Prof. L. Jayasinghe, and Prof. M.N. Wickramarathne	Natural Products	Ms. L. Jayawardana, Sabaragamuwa University of Sri Lanka
Dr. R. Liyanage, and Dr. Somarathne, T.	Nutritional Biochemistry	Ms. D.A.D.M. Jayasekara The Open University of Sri Lanka
Dr. R. Liyanage, Prof. C. S. De Silva, and Ms. S. A. D. S. S. Maheepala	Food and Nutrition	Ms. I. Rathnayaka The Open University of Sri Lanka
Prof. R.R. Ratnayake	Soil Carbon Sequestration	Ms. E.M.D. Perera The Open University of Sri Lanka
Prof. G. Seneviratne	Microbiology	Mr. S. Ekanayake Uva wellassa University
Prof. S. Seneweera, Prof. C. Boehmer	Application of nanotechnology to manage Fall armyworm in Maiz	Ms. P. S. Jayalath Hochschule Rhein-Waal, Germany
Prof. S. Seneweera, and Dr. C. P. Rupasingha	Source and sink manipulation to optimize the yield potential of rice in Sri Lanka (***Thesis submitted)***	Mr. B. H. I. A. Jayathissa University of Ruhuna
Prof. L.R.A.K. Bandara, Dr. V.A. Seneviratne, and **Prof. N.D. Subasinghe**	Thermoelectric Effect	Mr. K.U. Perera University of Peradeniya
Prof. L.R.A.K. Bandara, Dr. V.A. Seneviratne, and **Prof. N.D. Subasinghe**	Thermoelectric Effect	Mr. I.G.H.U.Kumarasinghe University of Peradeniya
Dr. S. Jayawardhana, and **Dr. C.T.K. Tilakaratne**	Mapping the contribution of NIFS to the National policy framework on vistas of prosperity and splendor	Mr. D.M.A.D. Dissanayake Universityof sri jayewardenepura
Dr. H.W.M.A.C. Wijaya-singhe, and Mr. H.P.T.S. Hewathilake	Development Sri Lankan vein graphite for Li-ion Rechargeable batterries	Ms. Tamali Bandara Uva Wellassa University, Badulla
Prof. D.S.A. Wijesundara, and Dr. B Marambe	Agriculture and Invasive plants	Mrs. M. S Saranasooriya University of Peradeniya

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. R. Weerasooriya	Water Chemistry	Ms. T. K. S. Priyangani University of Peradeniya
Prof. R. Weerasooriya	Material Science	Mr. H. A. N. H. B. Senanayaka University of Peradeniya

B.3 Undergraduate Industrial training projects

Supervisor/s	Name of the student/ Affiliated University
Dr. L. Jayarathna	Ms. P.G.K.Paranagama, University of Ruhuna
Prof. L. Jayasinghe	Ms. S. M. K. T. Samarakoon, Nilai University
Prof. L. Jayasinghe	Ms. N. Jayasekara, Rajarata University of Sri Lanka
Prof. G.R.A. Kumara, and Dr. C. Rupasinghe, and	Ms. G.W.N.M.G. Waduge, University of Ruhuna
Dr. R. Liyanage, and Dr.B. L. W. K. Balasooriya	Ms. S. D. H. Kaushalya , Wayamba University of Sri Lanka
Prof. J.M.N. Marikkar	Ms. S. .A.F. Rushdah, University of Jaffna
Prof. R.R. Ratnayake	Mr. J.A.V.R. Jayasinghe from Horizon Campus, Malambe
Prof. R.R. Ratnayake	Ms. K. Sanuja, University of Jaffna
Prof. R.R. Ratnayake	Ms. W.G.C.M. Wijekoon, University of Jaffna
Prof. G. Seneviratne	Ms. N. Thakshila, University of Ruhuna
Prof. G. Seneviratne	Ms. S. Thilakaratne, Rajarata University of Sri Lanka
Prof. S. Seneweera, and Dr. P. Warakagoda	Ms. J.W. Welagedara, Wayamba University of Sri Lanka
Prof. N.D. Subasinghe	Mr.V. Thilakanayaka, Chinese Academy of Sciences
Prof. R. Weerasooriya	Ms. T. G. K. D. Samaraweera, University of Peradeniya

B.3 Other Training facilitated

Supervisor/s	Research area	Name of the student/ Affiliated Institute
Prof. W.P.J. Dittus	Primate Biology	Ms. T. Hettiarachchi Association for the Conservation of Primate Diversity (ACPD)
Dr. R. Liyanage	Food Science	Ms. H. M. G. S. Bandara
Dr. R. Liyanage	Nutritional Biochemistry	Ms. L. Yogarathnam
Prof. D.N. Magana-Arachchi	Molecular Microbiology	Ms. W.R.U.A. Bandara
Prof. D.N. Magana-Arachchi, Prof. M. Vithanage, and Dr. R.P.Wanigatunge	Cyanobacteria	Ms. K.D.H.S.M.S. De Silva
Prof. D.N. Magana-Arachchi	Molecular microbiology	Ms. J.M.S.D. Jayalath
Prof. D.N. Magana-Arachchi	Molecular microbiology	Ms. W.A.K. Perera
Prof. R.R. Ratnayake	Paddy soil ecosystems	Mr. E.A.D.H. Edirisinghe University of Peradeniya
Prof. R.R. Ratnayake	Soil Carbon Sequestration	Ms. U.L.R.W. Premathilaka
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	Soil Carbon Sequestration	Ms. S.U. Galketiyahewage
Prof. R.R. Ratnayake	Microbiology	Miss. M.M.P.H. Jayasinghe
Prof. G.K.R. Senadeera	Quantum dot sensitized solar cells	Mr. Chathura Madhubhashana Gunasekara
Prof. G. Seneviratne	Microbiology	Mr. W. M. K. D. S. Warnakulasooriya
Prof. S. Seneweera	Wildlife biology and conservation	Ms. N.D.H. Vinodhya
Prof. S. Seneweera, Dr. C. Perera	Plant Molecular Physiology	Ms. W. H. M. V. P. Edirisinghe
Prof. S. Seneweera, and Dr. J. Epaarachchi	Crop health	Ms. C.H. Samarasinghe
Prof. R. Weerasooriya	Material Chemistry	Mr. R.T. Perera University of Kelaniya

PATENTS

- National Institute of Fundamental Studies . (2020). *A method of recovering waste graphite attached to wall rocks in vain graphite mines*, Sri Lanka [Patent No : 19596].

- National Research Council,, and National Institute of Fundamental Studies . (Filing Date :2020-06-16). *Microwave-assisted synthesis of nano zeolite-A with the aid of sodium dodecyl sulfate (SDS) as particle size-controlling agent*, Sri Lanka.

- National Research Council, and National Institute of Fundamental Studies . (Filing Date :2020-06-16). *Hydrothermal synthesis of nano zeolite-A with the aid of sodium dodecyl sulfate (SDS) as particle size-controlling agent*, Sri Lanka.

AWARDS & RECOGNITIONS 2020

Awards:

Most Outstanding Researchers

- Dr. Renuka Ratnayake - Research Fellow / Senior Research Fellow Category
- Prof. Suresh Benjamin - Associate Research Professor Category
- Prof. Rohan Weerasooriya - Research Professor Category
- Prof. Lalith Jayasinghe - Senior Research Professor Category

Research Publication Excellence

- Dr. Gayan Bowatte
- Prof. Saman Seneweera
- Prof. Jayasundera Bandara
- Dr. Ruvini Liyanage
- Dr. Chathuni Jayathilake
- Ms. Rizliya Visvanathan
- Prof. Rohan Weerasooriya

NIFS Three minutes Thesis competition (Post graduate category)

1st place: Ms. Afka Deen
2nd place: Ms. Surekha Balasooriya
3rd place: Ms. Surendranie Cabral de Mel

NIFS Three minutes Thesis competition (Under graduate category)

1st place: Ms. Upuli Nakandala
2nd place:Ms. Maheshika Perera
3rd place: Ms. Nirmani Thilakarathne

Prof. G.K.R. Senadeera received a National Award for OUSL Research Award

Recognitions:

- **<u>Reviewer for Reviewing a Manuscript for Journal Publication in 2020:</u>**

Prof. S.P. Benjamin
ZooKeys

Prof. M.A.K.L. Dissanayake
Electrochimica Acta

Prof. W.P.J. Dittus
American Journal of Primatology
Human Dimensions of Wildlife
International Journal of Primatology
Journal of Medical Primatology
Journal of Threatened Taxa

Prof. M.C.M. Iqbal
Bioremediation journal
Journal of National Science Foundation

Prof. G.R.A. Kumara

SN Applied Sciences
Chemical Engineering Journal

Dr. R. Liyanage

Journal of Food Processing and Preservation
Journal of the Science of Food and Agriculture

Prof. D.N. Magana-Arachchi

Journal of Current Microbiology
Journal of Environmental Management
Journal of Infectious Diseases

Prof. J.M.N. Marikkar

Ceylon Journal of Science
International Food Research Journal
Italian Journal of Food Science
Journal of Food Biochemistry
LWT-Food Science and Technology
Sri Lanka Journal of Technology

Prof. G.K.R. Senadeera

Journal of Material Science: Materials in Electronics

Prof. N.D. Subasinghe

Journal of the Geological Society of Sri Lanka

Reviewer in International / National Conference in 2020:

Prof. M.A.K.L. Dissanayake

National Conference on Multidisciplinary Research
Cyril Ponnamperuma Memorial International Conference on Multidisciplinary Research
PGIS Research Congress

Dr. R. Liyanage

Environmental Monitoring and Management conference
6th International Conference on Dry Zone Agriculture in 2020
Postgraduate Institute of Agriculture, University of Peradeniya

Prof. D.N. Magana-Arachchi

International Conference on Environmental Management & Monitoring (EMM), University of Peradeniya
PGIS Research Congress

Prof. J.M.N. Marikkar

National Conference on Multidisciplinary Research 2020
Institute of Biology Sri Lanka annual conference

Prof. G.K.R. Senadeera

Open University Research Session, conference proceeding

Prof. N.D. Subasinghe

International Conference on Environmental Monitoring & Management
National Conference on Multidisciplinary Research

Journal Editor:

Prof. M.A.K.L. Dissanayake

National Conference on Multidisciplinary Research
Cyril Ponnamperuma Memorial International Conference on Multidisciplinary Research
Ceylon Journal of Science

Prof. D.S.A. Wijesundara

MycoAsia i
Sri Lanka Journal of Food and Agriculture
Tropical Agricultural Research
Wildlanka

Evaluator/ Examiner:

Prof. M.C.M. Iqbal

Reviewer for Grant proposal for University of Sri Jayewardenepura
Reviewer for Grant proposal for National Research Council

Prof. G.R.A. Kumara

Evaluator for PGIS Research Grants
Evaluator for NRC Research Grants

Dr. R. Liyanage

Examiner for External Examiner of the Research Project , Faculty of Science, University of Peradeniya
Examiner for B.Sc.in Agriculture Degree, Rajarata University of Sri Lanka

Prof. D.N. Magana-Arachchi

Examiner for PhD Thesis in PGIS
Evaluator for NRC Grant Final Report
Reviewer for NSF Competitive Research Grants
Reviewer for PhD Thesis in PGIS

Prof. G.K.R. Senadeera

Examiner for M.Phil thesis

Prof. N.D. Subasinghe

Evaluator for NRC Grant Progress Report
Reviewer for NSF Competitive Research Grants

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
Ministry of Skills Development & Vocational Training and Sustainable Energy

Prof. W.P.J. Dittus

Expert Consultant at Ministry of Environment, Government of Sri Lanka

Prof. M.C.M. Iqbal

Member of the Board of Governors of the NIFS
Member of the General Research Committee, Sri Lanka Association for the Advancement of Science on 2020-01-01.
Member of the Board of Study for Crop Science, Postgraduate Institute for Agriculture

Prof. R.R. Ratnayake

Member at Committee on Development of Ecosystem Services Indicators & Guidelines - Central Environmental Authority
Member at Board of Molecular Biology & Biochemistry, Postgraduate Institute of Science, University of Peradeniya, Sri Lanka

Prof. N.D. Subasinghe

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

Member at Board of Earth Sciences, Postgraduate Institute of Science, University of Peradeniya, Sri Lanka

Member of the NSF-NTRP Steering Committee on Oceanography and Marine Sciences

Prof. D.S.A. Wijesundara

Chairman at Scientific and Research Sub-Committee on UNESCO World Heritage Sites in Sri Lanka

Co-Chairman at National Invasive Species Specialist Group, Ministry of Environment

Chairman at National Species Conservation Advisory Group, Ministry of Environment

Chairman at National Committee on Man and Biosphere, National Science Foundation

Chairman at Scientific and Research Sub-Committee on UNESCO World Heritage Sites in Sri Lanka

Council Member at Council of University of Peradeniya

Other recognitions:

- Prof. S.A. Kulasooriya Member of 'Go Green' environmental programme, Kandy society of medicine
- Dr. R. Liyanage Visiting Lecturer at Department of Bio Systems Technology, University of Jaffna
- Dr. R. Liyanage Moderator/BSc (Special Degree) in Agriculture, at Rajarata University of Sri Lanka
- Dr. R. Liyanage Evaluator, 32nd Annual Congress, PGIA, University of Peradeniya
- Prof. J.M.N. Marikkar received the Chairperson of the Technical Session I, 32nd Annual Congress of the Postgraduate Institute of Agriculture from PGIA of University of Peradeniya
- Prof. N.D. Subasinghe Chaired a Session at Annual Sessions of the Geological Society of Sri Lanka
- Prof. N.D. Subasinghe Resource Person at ACBT College, Kandy

TRAINING & PARTICIPATION

Training

- Ms. D.D.M.O. Dissanayake, and Ms. T.M. Paranavithana trained at a National Workshop on *122 nd-6 -day Residential Short Course on (Advance course) GIS and Applications* from 2020-10-21 to 2020-12-26 at Department of Geology, University of Peradeniya.

- Ms. J.M.K.W. Kumari, Mr. K. Umair, and Ms. W.I. Sandamali trained at a National Workshop on *Training workshop on AFM and XRD: Effective research tools for material research* from 2020-09 -12 to 2020-09-13 at Department of Physics, University of Jaffna.

- Ms. T.M. Paranavithana, and Ms. D.D.M.O. Dissanayake trained at a National Programme on *117th 6 day Residential Short Course on* from 2020-02-10 to 2020-02-15 at Postgraduate Institute of Science(PGIS), University of Peradeniya.

- Prof. G.K.R. Senadeera, Ms. J.M.K.W. Kumari and Ms. J.U. Halpegama trained at an International Programme on *Introductory training course in nano-fabrication technologies* from 2020-02-04 to 2020-02-24 at Indian Institute of Science (IIS), Bangalore, India.

- Ms. S.M.N.K. Thilakarathne trained at an International Workshop on *Hands on training in Computational Biology for (Meta) Genomics Analysis* on 2020-02-12 at Pokhara, Nepal.

Participation

- Ms. T.K. Bowange, and Ms. R. Premathilaka Participated at an International Workshop on *Agilent chromatography, mass spec and spectroscopy seminar* on 2020-01-07 at Hotel Hilton, Colombo.

- Mr. T. Jaseetharan, Ms. J.M.K.W. Kumari, Mr. Umair, and Mr. S. Senthuran Participated at an International Conference on *7th Ruhunan International Science and Technology Conference* on 2020-01-22 at Faculty of Science, University of Ruhuna

- Ms. H.M.H.D.K. Naranpanawa Participated at a National Conference on *Chemical Technology for Value Addition to Local Resources* on 2020-02-14 at SLECC, Colombo.

- Ms. H.M.H.D.K. Naranpanawa Participated at a National Conference on *Postgraduate Institute of Science Research Congress 2020* from 2020-11-26 to 2020-11-28 at Postgraduate Institute of Science, University of Peradeniya.

- Ms. H.M.H.D.K. Naranpanawa Participated at a National Conference on *36th Annual Technical Sessions, "Global Challenge and the Role of Geologist"* on 2020-02-28 at Solis Hotel, Pita Kotte.

- Mr. H.T.G. Shashintha, Ms. J.M.K.W. Kumari, Mr. K. Umair, and Ms. W.I. Sandamali Participated at a National Symposiums on *National Conference on Multidisciplinary Research (NCMR-2020)* on 2020-10-08 at National Institute of Fundamental Studies.

- Mr. K. Umair Participated at a National Conference on *PGIS Research Congress 2020* from 2020-11-26 to 2020-11-28 at Postgraduate Institute of Science, University of Peradeniya.

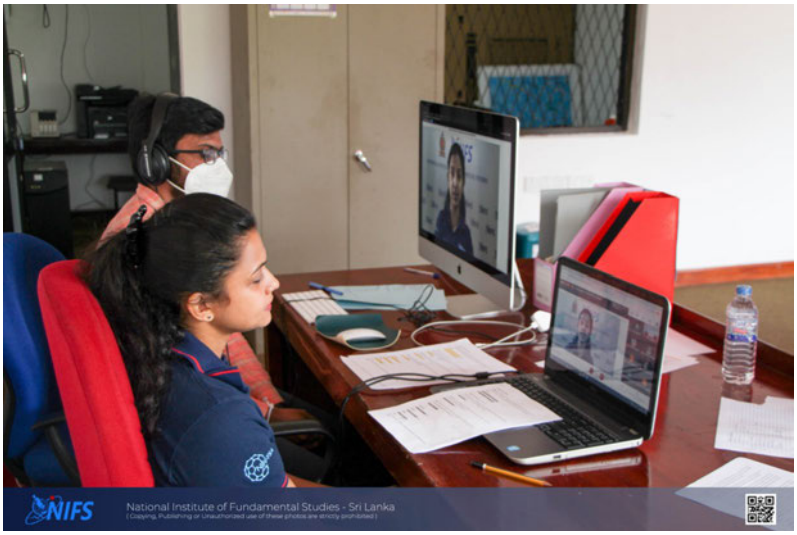
DISSEMINATION OF SCIENCE

Conferences & Workshops:

- International Conference :
  "Cyril Ponnamperuma Memorial International Conference on Multidisciplinary Research 2020" was held for the Scientific Community at the Large Auditorium, NIFS on 2020-01-21 with 249 participants.
  Resource Persons :
  Prof. K. Tennakone, Mr. N.Gunawardene, Prof. A. Sandanayaka, Dr. P. Katulanda, Prof. C. Herath, Prof. V. Karunaratne, Prof. S.A. Kulasooriya, and Prof. D. Fernando

- *Annual Research Review 2019"* was organized for the Scientific Community at the professor Ciril Ponnamperuma auditorium on 2020-07-30 with 150 participants.
  Resource Persons : Keynote Address, Prof. Brajesh Singh (Director, Global Centre for Land-Based Innovation), Western Sydney University, Australia, (via ZOOM).

- *National Conference on Multidisciplinary Research (NCMR) 2020, Virtual Postgraduate Symposium"* was organized by the Young Scientists' Association (YSA) of the National Institute of Fundamental Studies (NIFS) and Science Education and Dissemination Unit for the Scientific Community at the Professor Ciril Ponnamperuma Auditorium on 2020-10-08 with 126 participants.
  Resource Persons : The keynote address of NCMR 2020 was delivered by Prof. Nilwala Kottegoda, Professor at University of Sri Jayawardenapura, A guest talk was also delivered by Dr. Hasini Jayathilaka.



- Workshop : *"How to write an effective abstract"* was organized by the Office for Research Support and SEDU for the Scientific Community at the professor Ciril Ponnamperuma auditorium on 2020-07-08 with 69 participants.
  Resource Persons : Prof. M.C.M. Iqbal

- *Three Minute Thesis (3MT) Competition :*
  The Three Minute Thesis (3MT) Competition was organized by the Young Scientists Association (YSA) of the National Institute of Fundamental Studies (NIFS) Kandy for year 2019. The preliminary round of the competition was held in December 2019, and the finals of the event was held on the 28th of January 2020 at the Cyril Ponnamperuma Auditorium of the NIFS. The keynote speaker for the final event was Professor Janaka Bandara Ekanayake from the University of Peradeniya who provided us with an insight on how to conduct effective research. The panel of judges of the competition comprised of Professor Veranja Karunarathna of Department of Chemistry University of Peradeniya, Professor Ashoka Dangolla, Department of Veterinary Clinical Science, University of Peradeniya, and Professor Buddi Marambe of Department of Crop Science University of Peradeniya. This competition gave an opportunity for the budding scientists at NIFS to develop their presentation skills and to communicate science in a language appropriate to a non-scientific audience, which would be immensely beneficial in their future careers.

Speeches:

- *"Imagine, Knowledge, responsibility and refashioning our identity"* was organized by the Office for Research, Young Scientists Association of NIFS and SEDU for the Scientific Community at the professor Ciril Ponnamperuma auditorium(zoom lecture) on 2020-06-18 with 41 participants. Resource Persons : Dr. Vagisha Gunasekara,Senior Lecturer,Open University of Sri Lanka.

- *"How Phone Microscoy and AI is Transforming Agriculture"* was organized by the Science Education and Dissemination Unit for the Scientific Community at the Professor Cyril Ponnamperuma Auditorium,NIFS on 2020-01-07 with 23 participants.
  Resource Persons : Mr.Sivam Krish (Founder and CEO Gomicro).

Other Presentations:

- Ranasinghe, U.G.S.L., Eberle, J., Bohacz, C., Benjamin, S.P., and Ahrens, D. (2020). *Local and Regional scale patterns of biodiversity of Sericini chafers (Coleoptera: Scarabaeidae) in Sri Lanka*. Poster, Centrum für Naturkunde Zoologisches Museum, Universität Hamburg, Hamburg.

- Subasinghe, N.D. (2020). *Black Holes, Neutron Stars and White Dwarfs*. Invited Speech, Kingswood College, Kandy.

- Wijesundara, D.S.A. (2020). *Plants of Sri Lanka and Their Conservation*. Presentation, IOB Webinar Series

- Magana-Arachchi, D.N. (2020). *Air Pollution and Infection*. Invited Speech

Dissemination through printed media:

- Benjamin, S.P. (2020-11-24), නව මකුළුවන් විශේෂ 104ක් ලොවට හඳුන්වා දුන් ශ්‍රී ලාංකික මහාචාර්යවරයා. *BBC සිංහල* p.1.
- Prof.Sumathipala,A., and Dr.Fernando,B (2020-09-30), Research for people's benefit. *The Island* p.1.
- Prof.Sumathipala, A., (2020-11-06), Depression can make you more vulnerable to Covid – Psychiatrist Prof Sumathipala, economynext.com (https://economynext.com/depression-can-make-you-more-vulne…/)
- Prof. Seneviratne, G. (2020-05-20), Victory of a fifteen year attempt: Biofilm biofertilizer (Sinhala). *Aruna* p.14.
- Prof. Seneviratne, G. (2020-05-20), Hundred percent natural and organic Biofilm biofertilizer (Sinhala). *Ada* p.10.
- Prof. Seneweera, S. (2020-10-07), අලි 6000 ප්‍රශ්නයට නොවරදින විසඳුමක්. *Dinamina* p.1.
- Prof. Seneweera, S. (2020-10-10), ලෝකයටම බැටරි හදන්න තරම් මිනිරන් ලංකාවේ තියෙනවා. *Dinamina* p.1.
- Prof. Seneweera, S. (2020-11-01), විදුලි වැටෙන් අලි උවදුරු දුරුවෙයිද?. *Lankadeepa* p.1.
- Prof. Seneweera, S., Wijesinghe, A., and Seneviratne, G. (2020-10-17), ලෝකයටම අලුත් නිපැයුම් තනන කඳුකර විද්‍යාගාරය. *දිනමිණ* p.1.
- Prof. Subasinghe, N.D., and Herath, P. (2020-09-06), Did the ground vibration in Kandy caused by an earthquake? (Sinhala). *Lankadeepa* p.27.
- රටේ වායු දූෂණය 'බිංදුවටම' බහියි , සිළුමිණ (2020-05-02)
- Prof. Wickramasinghe , C. Life on Earth, Pandemics and the Covid-19 disaster
  The Island | October 25, 2020
- Wastewater as a cheap and rapid surveillance tool for virus NIFS & Kandy National Hospital come up with novel early warning method to face the new normal
  The Sunday Times | Sunday, December 13, 2020
- Sri Lanka, home to four new beetle species
  http://www.themorning.lk/sri-lanka-home-to-four-new-beetle…/

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 [දැනුමින් පිරිපුන් සමාජයක් බිහිකිරීමේ අභිලාෂය පෙරදැරිව ජාතික මූලික අධ්‍යයන ආයතනය විසින් ''හෙට ලොව දිනන විදු පර්යේෂණ'' සාකච්ජා මාලාව]
  Episode 01, Resource Persons : Prof. S.P. Benjamin**,** and Dr. S. Rajakaruna
  Episode 02, Resource Persons : Dr. L. Jayarathna, and Dr. S. Rajakaruna

- A week-long series of short video lectures were organized to coincide with National Science Day has been released into cyberspace to mark the National Policy Framework as a reality, with the aim of contributing to a technology-based society and a knowledgeable nation. Our primary objective is to instill science literacy in our society and to make them aware by exposing the unseen beauties of science. These videos are a creation of the NIFS audio-visual section, which brings together collection of research results, research experiences, and scientific opinions from researchers at the NIFS.
  Short videos are as follows;
  - වායු දූෂණය සහ ක්ෂුද්‍රජීවීන් ;අණුක ක්ෂුද්‍රජීව විද්‍යාව සහ මානව රෝග පිළිබඳ පර්යේෂණ : ලෙඩ රෝගවලින් තොර රටක්,| මහාචාර්ය ධම්මිකා මාගන-ආරච්චි, https://www.youtube.com/watch?v=Yb0sGijQxXc
  - වන ස්නානය හෙවත් forest bathing; අපට මදක් හුරු නැති මාතෘකාවක් වුවත් මෙහිදී සිදුවන්නේ නිදහසේ වනාන්තරයක් තුළ ගමන්කිරීම හරහා අපගේ සෞඛ්‍ය තත්වය ඉහළ නංවා ගැනීමයි. | වානක ලේකම්ගේ මහතා, https://www.youtube.com/watch?v=o6FQmnMiX5Q
  - පෘථිවි සම්පත් සහ පුනර්ජනනීය බලශක්ති පර්යේෂණ ව්‍යාපෘතිය බලශක්තියෙන් පිරිපුන් රටක් | මහාචාර්ය එන්. ඩී. සුභසිංහ, https://www.youtube.com/watch?v=Yew41iCWqsg

- කහ යනු කුලුබඩුවක් පමණක්ම ද? ඖෂධීය ගුණයෙන්මෙන්ම ජෛව විද්‍යාත්මක ගුණාංගයන්ගෙන් පිරිපුන් කහ කුලුබඩුවක්ම නොව ප්‍රතිඔක්සිකාරකයක් ලෙස ක්‍රියා කර පිළිකා වැනි රෝගී තත්වයන් මැඩලීමටද දායක වේ.| සහනි උල්පත්කුඹුර මෙනෙවිය, https://www.youtube.com/watch?v=ZwZK92WOatM
- වියළි කලාපීය ජල ගැටලුවට අපගේ විසඳුම් | මහාචාර්ය රොහාන් වීරසූරිය, https://www.youtube.com/watch?v=ep1k6dhm7wA
- "තිරසාර හෙට දිනකට වස විසෙන් තොර සරුසාර අස්වැන්නක්", බයෝෆිල්ම් ජෛව පොහොර | මහාචාර්ය ගාමිණී සෙනෙවිරත්න, https://www.youtube.com/watch?v=tUHOSkzfWjo
- ජෛව රසායනික සංයෝග මගින් දියවැඩියාව පාලනය කරන්නේ කෙසේද? දියවැඩියාව සුව කරන ඖෂධ නිපදවීමට ශාක තුළ ජීවත් වන දිලිර කාණ්ඩයන්ගෙන් ලබා ගන්නා පරිවෘත්තීය ඵල යොදා ගත හැකිය.| සුරේඛා බාලසූරිය මෙනෙවිය; https://www.youtube.com/watch?v=GF1qEClwzz8
- Diabetes Awareness (Tamil Medium) | Prof. Nazrim Marikkar, https://www.youtube.com/watch?v=z60i8z1TJik
- වායු දූෂණය ; ලොව පුරා වෙසෙන ලොකු කුඩා සැමට එකසේ බලපාන වායු දූෂණය ඔබ අප සැමගේ පොදු ප්‍රශ්නයක් වී හමාරය.| ආචාර්ය ගයාන් බෝවත්ත, https://www.youtube.com/watch?v=4GYPT0HYo4U
- ලොව පුරා ජනප්‍රිය ක්ෂණික ආහාර රටාව අපට සුදුසු ද? කාර්යබහුල ජීවිතයේ අපි හැමෝම ලේසිය, පහසුව ගැන හිතලා තමයි ක්ෂණික ආහාර (fast food) සඳහා යොමු වන්නේ. හැබැයි මේ කෑම ලබාගන්න පහසුයි වගේම අපේ ශරීරයත් පහසුවෙන් මේ කෑම නිසා ලෙඩ වෙනවා. | රසිකා ගුණරත්න මෙනෙවිය, https://www.youtube.com/watch?v=Mx6Fo84a0w4
- ශ්‍රී ලංකාවේ ජෛව විවිධත්වය හා එහි සංරක්ෂණය: ගසක, මලක, තුරු වදුලක හැංගී තිබෙන මී වදයක, පියඹා යන සමනළ රැනක පමණක් නොව හිමිදිරි අහසක ඇදෙන, මැවෙන නෙක රටාවෝ ඔබ අත් විඳ නැති බව නම් නොරහසකි.| මහාචාර්ය සිරිල් විජේසුන්දර, https://www.youtube.com/watch?v= Fdk2qwbf3o

Dissemination through blog articles

- **Iqbal, M.C.M.** (2020-04-21), The present Covid-19 pandemic. *NIFS official page* p.Not assigned.
- Dr. Shalini Rajakaruna, (2020-06-01), Stop the next pandemic? Stop illegal wildlife trade! The role of wildlife trade in transmitting emerging diseases

Participation in TV/radio programs

- Prof. Athula Sumathipala, උත්සව සමයේ මහජන වගකීම, BIG FOCUS (https://youtu.be/RufslasyYRo)
- Prof. Athula Sumathipala, Sirasa Pathikada සිරස පැතිකඩ (https://www.youtube.com/watch?v=XC3g4QkX_fE)
- Prof. Athula Sumathipala, කොරෝනා වසංගත ව්‍යාප්තිය පාලනය හා ජනජීවිතය යථාතත්වයට පත්කිරීම පිළිබඳව රූපවාහිනී නුගසෙවන වැඩසටහනේ කළ සාකච්ඡාව-2020.05.15, (https://www.youtube.com/watch?v=6WKikGVD9qE)
- Prof. Athula Sumathipala ගුණවත් නැණවත් සෞඛ්‍යවත් පිරිසක් ඇති කිරීම පිළිබඳව රූපවාහිනී නුගසෙවන වැඩසටහනේ කළ සාකච්ඡාව- 2020.04.29, (https://www.youtube.com/watch?v=xzu_rz1NYvs)
- Prof. G. R. Asoka Kumara, සිරස පැතිකඩ-2020-09-21, (https://www.youtube.com/watch?v=8Xr4z70teEk)
- Prof. Gamini Seneviratne, අද දෙරණ සරු දෙරණ රූපවාහිනී වැඩසටහනේ කළ සාකච්ඡාව, (https://www.youtube.com/watch?v=7uFwicnM41Q)

- Prof. Gamini Seneviratne වී වගාව සඳහා පෙව පොහොර නිෂ්පාදනයට ජාතික මූලික අධ්‍යයන ආයතනය ලබා දුන් දායකත්වය , Big Focus (https://youtu.be/uKNV-9R9S5I)

- Prof.S.Seneweera , Doramadalawa Programme- 2020-02-24, (https://www.youtube.com/watch?v=nuuxBdh-5Q0)

- Prof. Saman Seneweera and Professor Lakshman Dissanayake. Discussion on National Institute of Fundamental Studies at Rupavahini Sanhinda Programme (https://www.nifs.ac.lk/…/tv-discussion-rupavahini-sanhinda)

- **Prof. N.D. Subasinghe** Resource Person at ACBT College, Kandy on 2020-03-30

Dissemination through International Documentary Films

- BBC Natural World: “Animal Babies: First Year in the Life of a Toque Macaque.”
- Animal Channel, & Discovery Channel “Mamas of toque macaques” Plimsoll Productions, UK.
- NHK, Japan Natural History Channel. “One male and his harem of Sri Lankan toque macaques face survival challenges” .

Exhibition stall:

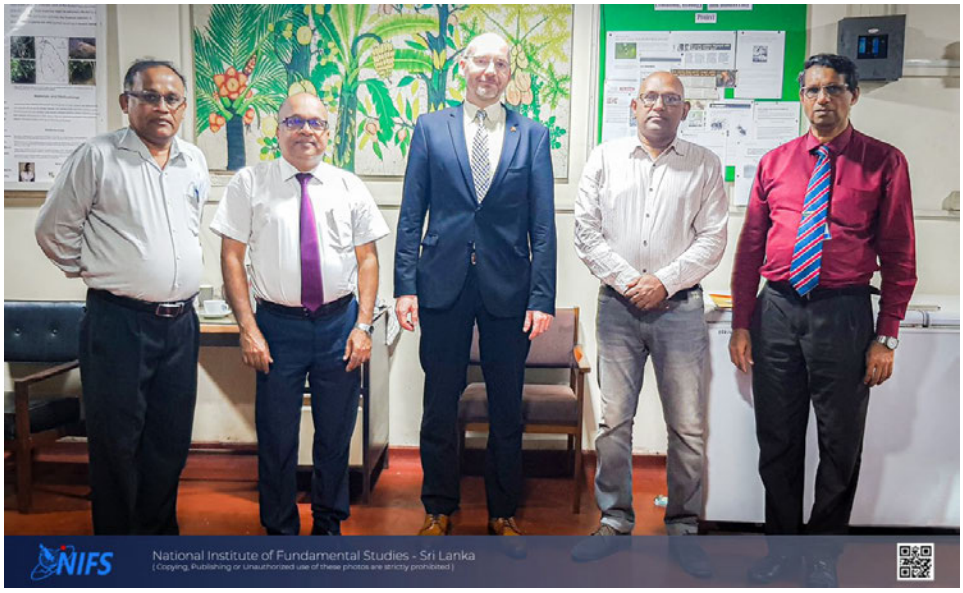
- National Exhibition :"*Inno Tech 2020*" was organized by the State Ministry of Technology and Innovation for the General Public at the Homagama-NSBM, NIFS had a stall and actively participated in the exhibition from 2020-03-11 to 2020-03-13 with 10000 participants. Resource Persons :Prof. M.C.M. Iqbal, Prof. R. Weerasooriya, Dr. A. Wijayasinghe, Jayaratne, L., Prof. S.P. Benjamin, Dr. R.R. Ratnayake, Dr. R. Liyanage, Prof. N.D. Subasinghe, Prof. D.N. Magana-Arachchi, Prof. N.K.B. Adikaram, Prof. G.K.R. Senadeera, Mr. N. Rajakaruna, Prof. M.A.K.L. Dissanayake, Prof. S.A. Kulasooriya, Prof. D.S.A. Wijesundara, and Prof. G.R.A. Kumara

Web site launching

The redesigned website of the NIFS, developed the Science Education and Dissemination Unit was launched by Hon. Dr. Bandula Gunawardana, Minister of Information and Communication Technology and Minister of Higher Education. Hon. Thilanga Sumathipala, State Minister of Technology and Innovation, the secretary of the state Ministry of Technology and Innovation, Mr. Chinthaka Lokuhetti, and the acting chairman of the board of governors of the NIFS, Mrs. Nazeema Ahamed graced the occasion.

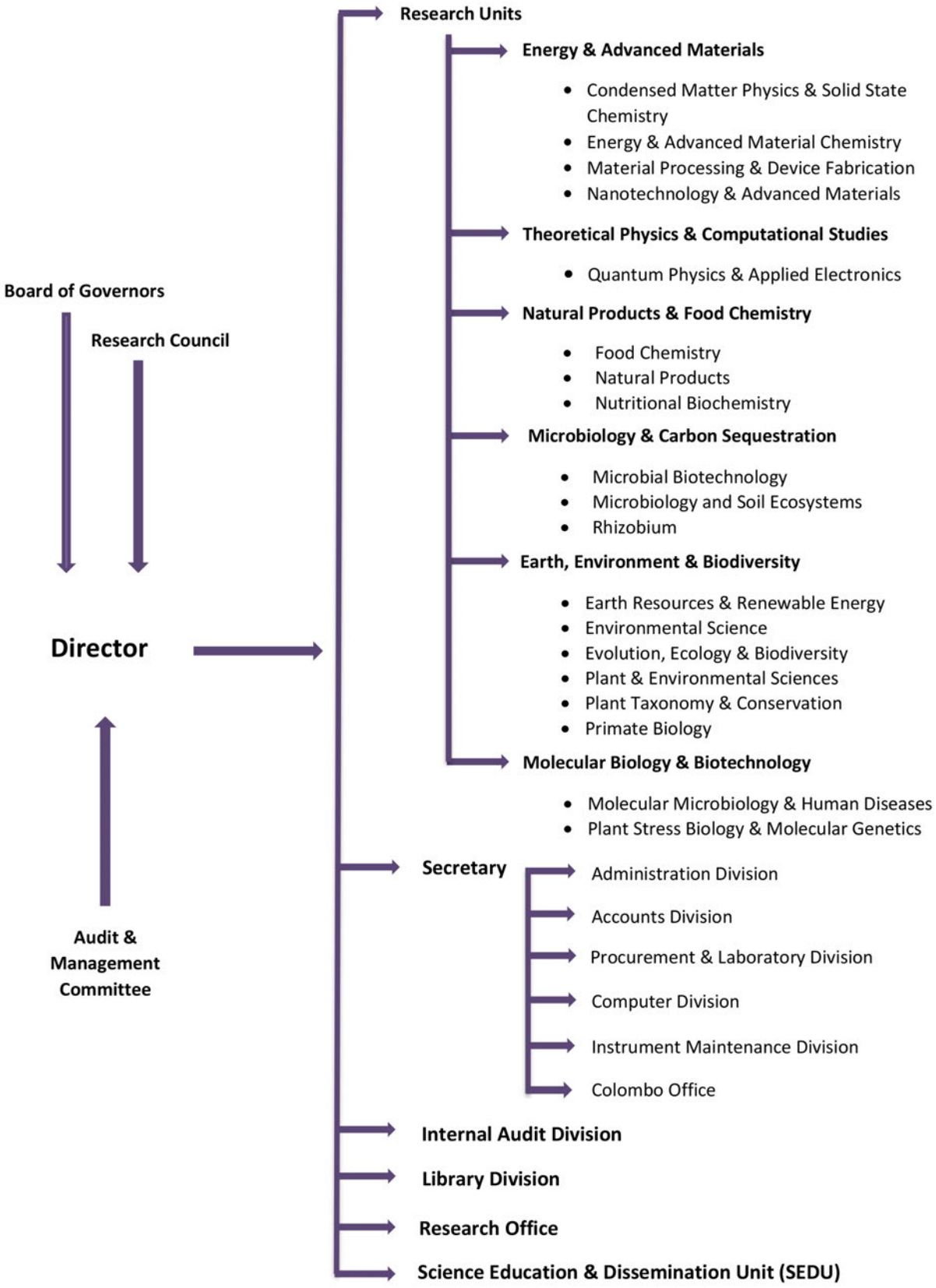
- *"Handing over ventilators to Teaching Hospital Peradeniya"* was organized by the Office for Research and SEDU for the Scientific Community at the Professor Ciril Ponnamperuma auditorium on 2020-06-19 with 30 participants.
  Team:Prof. Vasanthi Pinto (Senior lecturer), Dr. Arjuna Thilakarathne (Director), Teaching hospital Peradeniya, Prof. Kithsiri Liyanage(Senior lecturer)/University of Peradeniya, Director/NIFS, Mr. M. Kulathunga/NIFS, Mr. H. Herath/NIFS, Mr. M. Hasun/NIFS

- *Official Handing over of equipment - Alexander Von Hambold Foundation"* was organized by the Science Education and Dissemination Unit, Evolution, Ecology and Biodiversity Research Programme for the Scientific Community at the Professor Cyiril Ponnamperuma Auditorium on 2020-01-29 with 50 participants.
  Resource Persons : His Excellency Jörn Rohde German Ambassador to Sri Lanka & Maldives.



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 make 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,
Keele University,Staffordshire, UK

Ex-Officio members

1. The Advisor to the President on Scientific Affairs

Professor N. Kottegoda

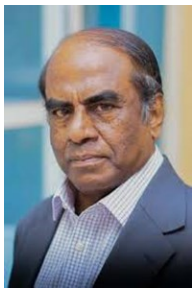
2. Chairman of the University Grants Commission

Professor S. Amaratunge

3. The Director, NIFS

Professor S. Seneweera

Member appointed by H.E the President



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

Professor Nishantha Perera
Department of Mathematics, University of Colombo

Member appointed by the Minister

Mr. Anura Dissanayke
Secretary to the Ministry of Irrigation

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

Member elected by the Research Council

Professor M.C.M. Iqbal
Associate Research Professor/ NIFS

Treasury representative

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

Secretary to the Board of Governors

Dr. P.S.B. Wanduragala

As at 31st December 2020

RESEARCH COUNCIL 2020

Research Council whose membership comprises of 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

Ex-Officio: Director/ NIFS

Prof. Saman Seneweera,

Members

Appointed by H.E the President

Prof. Jayasinghe R. D., Department of Oral Medicine and Periodontology Faculty of Dental Studies, University of Peradeniya

Prof. Yakandawala D.M.D., Department of Botany, Faculty of Science, University of Peradeniya

Ex-Officio:

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

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

Elected by the Research Fellows of National Institute of Fundamental Studies

Dr. Jayaratne I.P.L. , Research Fellow (on contract)

Nominated by the University Grant Commission

Prof. Ravirajan P., Department of Physics, Faculty of Science, University of Jaffna
Professor De Silva K.N., Department of Chemistry, Faculty of Science, University of Colombo
Professor Senaratne A., Department of Geology, Faculty of Science, University of Peradeniya
Professor Vithanage M., Office of the Dean, Faculty of Applied Sciences, University of Sri Jayewardenepura,

Secretary to the Research Council

Dr. Wanduragala P.S.B.

As at 31st December 2020

OFFICE OF THE DIRECTOR

Professor Saman Senaweera
Director, National Institute of Fundamental Studies (NIFS)

Dr. P.S.B. Wanduragala
Secretary to the Board of Governors (NIFS)

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

Accounts Division

From left:

Seated Mrs. P.S.S. Samarakkody

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

Administration Division

From left:

1st row: Mr. D.G.K. Dorakumbura, Mr. A.V.A.P.Kumara, Mr. A.G.S.T. Gunathilake , Mr. D.G. Gunathilake, Mr. K.A.S.D. Kuruppuarachchi ,Ms. C.L.S.Illangakoon, Ms. R.P.M. Weerasooriya, and Ms. C. Ranasinghe

2nd row: Mr. T.R. Peiris , Mr. H.A.D.N. Jayasinghe , Mr. M.A.G.Somananda, Mr. M.G.D.K. Malwewa, Mr. D.W.G.A.C. Dodamwela, Mr. P.G.N.S. Wijewardena, Mr. U.B.R.S. Udapitiya, Mr. K.G.T.B. Gunasekara, and Mr. D.M.D.B. Dissanayake,

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

Internal Audit Division

Mr. W.M.I.U.B. Wijesinghe

Library

From left: Ms. T.C.P.K. Tilakaratne, Ms. R.M. Witharana

Procurement & Laboratory Stores Division

From left:
Standing: Ms. G.W.R.P. Chandrakanthi, Ms. H.M.T.L. Sumanarathne
Seated : Ms. W.D.S.P. Perera

Research Office

From left: Dr. S. Rajakaruna, Ms. T.P. Wijewickrama

Science Education & Dissemination Unit

From left:
Standing: Mr. G.C.K.S. Bandara, Mr. V.M. Ekanayake, Mr. M.C.V.B. Senevirathne, Ms. D. Seneviratne, H.M.G.N.N. Herath, Ms. K.I.K. Samarakoon
Seated: Dr. C.T.K. Tilakaratne

STAFF LIST

Director : Prof. Seneweera S.
Secretary : Dr. Wanduragala P.S.B.

Research Staff

Senior Research Professors

Prof. Bandara J. M. S.
Prof. Jayasinghe U. L. B.
Prof. Nanayakkara A. (up to 2/9/2020)
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 01/06/2020)
Prof. Senadeera G.K.R. (up to 30/11/2020)

Visiting Research Professor (Honorary)

Prof. Dittus W.P.J.

Visiting Associate Research Professor

Prof. Vithanage M.S. (up to 3/8/2020)

Visiting Scientist (Honorary)

Dr. Dissanayake D.M.R.E.A (from 17/11/2020)
Dr. Bowatte G.

Visiting Research Fellow

Dr. Thotawatthage C. (01/07/2020 to 30/09/2020)

Adjunct Professors (Honorary)

Prof. Choudhary I.	Prof. Dallavalle S.
Prof. Dharmadasa I. M.	Prof. Fernando D.
Prof. Fujimoto Y.	Prof. Guruge K.
Prof. Herath C.	Prof. Hirotsu N.
Prof. Ismail N. H.	Prof. Karunaratne V.
Prof. Nammi S.	Prof. Nikolai Kuhnert N.
Prof. Rupasinghe V.	Prof. Sandanayake A.
Prof. Tennakone K.	Prof. Wei Y.
Prof. Wickramasinghe C.	Prof. Zhenbo Xu

Research Assistants

Air pollution & risk Management

Mr. Senaratna M.	Grant Research Assistant

Condensed Matter Physics & Solid State Chemistry Research project

Ms. Kumari J.M.K.W.	NIFS Research Assistant Gr. I
Mr. Umair K.	NIFS Research Assistant Gr. II
Ms. Hettiarachchi M.S.H.	NIFS Research Assistant Gr. II (from 16/11/2020)
Mr. Jaseetharan T.	Grant Research Assistant
Ms. Sandamali W.I.	Grant Research Assistant
Mr. Senthuran S.	Grant Research Assistant

Earth Resources & Renewable Energy Research project

Ms. Abeysinghe A.M.A.M.	NIFS Research Assistant Gr. II (from 01/12/2020)
Mr. Bandara H.M.D.A.H.	NIFS Research Assistant Gr. II (up to 1/4/2020)
Mr. Rathnayake R.A.	NIFS Research Assistant Gr. II
Mr. Abewardena Pahan	Grant Research Assistant
Ms. Dissanayake D.W.M.S.	Grant Research Assistant
Mr. Wijekoon W.M.H.S.	Grant Research Assistant
Ms. Wijeratne G.	Grant Research Assistant

Energy & Advanced Material Chemistry Research project

Ms. Farhana M. A.	NIFS Research Assistant Gr. II
Mr. Subaseela K. M. de Silva	NIFS Research Assistant Gr. II (up to 16/09/2020)
Ms. Ubeysekara H.G.D.P.	NIFS Research Assistant Gr. II
Ms. Rajapaksha M.C.M.	Voluntary Research Assistant
Mr. Sumithraarachchi S.A.D.A.V.	Grant Research Assistant

Evolution, Ecology & Biodiversity Research project

Ms. Sathkunanathan A.	NIFS Research Assistant Gr. II
Ms. Tharmarajan M.	NIFS Research Assistant Gr. II
Ms. Bopearachchi D.	Grant Research Assistant

Food Chemistry Research project

Ms. Gunarathne K.M.R.U	NIFS Research Assistant Gr. II
Ms. Marasinghe S.S.K.	NIFS Research Assistant Gr. II (up to 30/11/2020)

Material Development & Pollutants Remediation

Ms. Amarasena R.A.L.R.	NIFS Research Assistant Gr. II (from 24/11/2020)
Ms. Perera M.D.R.	NIFS Research Assistant Gr. II (from 16/11/2020)
Ms. Rajapakshe A.	Grant Research Assistant

Material Processing & Device Fabrication Research project

Mr. Dissanayake P.N.	NIFS Research Assistant Gr. II
Ms. Kumarasinghe K.D.M.S.P.K.	NIFS Research Assistant Gr. I
Mr. Karunarathne D.G.B.C.	Grant Research Assistant

Microbial Biotechnology Research project

Ms. Meepegamage S.W.	NIFS Research Assistant Gr. II
Mr. Premarathna U.M.B.	NIFS Research Assistant Gr. II
Ms. Rathnathilake A.T.D.	NIFS Research Assistant Gr. II
Mr. Ekanayake Sidath	Grant Research Assistant
Mr. Warnakulasooriya Dilan	Grant Research Assistant

Microbiology & Soil Ecosystems Research project

Ms. Dissanayake D.D.M.O.	NIFS Research Assistant Gr. II
Ms. Paranavithana T.M.	NIFS Research Assistant Gr. II (from 16/11/2020)

Molecular Microbiology & Human Diseases Research project

Ms. Bandara W.R.U.A.	NIFS Research Assistant Gr. II (from 15/12/2020)
Ms. Thilakarathne S.M.N.K.	NIFS Research Assistant Gr. II (up to 28/3/2020)
Ms. Samarakoon T.M.U.E.K	NIFS Research Assistant Gr. II (from 28/12/2020)
Ms. Samarasinghe D.G.S.N.	NIFS Research Assistant Gr. II
Ms. De Silva K.D.H.S.M.S.	Grant Research Assistant (from 01/01.2020)
Ms. Ekanayake E.M.A.U.	Grant Research Assistant (up to 31/07/2020)
Ms. Madamarandawala J.M.P.S.	Grant Research Assistant (up to 30/11/2020)
Ms. Saseevan S.	Grant Research Assistant (from 02/09/2020)
Ms. Senevirathna M.A.T.M.	Grant Research Assistant (up to 09/09/2020)
Ms. WeerarathneW.B.C.P.	Grant Research Assistant (from 05/02/2019)

Nanotechnology & Advanced Materials Research project

Mr. Fernando W.T.R.S.	NIFS Research Assistant Gr. II (from 08/12/2020)
Ms. Naranpanawa H.M.H.D.K.	NIFS Research Assistant Gr. II (from 01/12/2020)
Mr. Samarakoon I.B.	NIFS Research Assistant Gr. II

Natural Products Research project

Ms. Dissanayake D.M.D.M.	NIFS Research Assistant Gr. II (up to 31/08/2020)
Ms. Kaushalya H.S.T.	NIFS Research Assistant Gr. II (up to 14/9/2020)
Ms. Kalinga J.C.	NIFS Research Assistant Gr. II (from 01/12/2020)
Ms. Siriwardhane K.D.P.U.	NIFS Research Assistant Gr. II (from 01/12/2020)
Ms. A.G.A.W. Alakolanga*	Grant Research Assistant (from 15.09.2020) * on leave from Uwa Wellasse University
Ms. H.M.S.K. Bandara	Grant Research Assistant
Ms. B.M.S.N. Balasooriya	Grant Research Assistant (Up to 30/09/2020)
Ms. Jayasekara S.K	Grant Research Assistant (from 01.11.2020-31)
Ms. Perera E.A.I.A	Grant Research Assistant (up to 15/11/2020)
Ms. S.M.K.T. Samarakoon	Grant Research Assistant

Nutritional Biochemistry Research project

Ms. Deen F.A.	NIFS Research Assistant Gr. II (up to 31/10/2020)
Ms. Sewwandi S.M.V.K.	NIFS Research Assistant Gr. II

Plant & Environmental Sciences Research project

Mr. Dissanayake D.M.R.E.A.	NIFS Research Assistant Gr. I (up to 3/10/2020)
Ms. Karunaratne H.G.M.K.	NIFS Research Assistant Gr. II

Plant Taxonomy & Conservation Research project

Mr. Jayasinghe H.D.	NIFS Research Assistant Gr. II
Mr. Lekamge P.L.C.U.S.B.	NIFS Research Assistant Gr. II

Plant Stress Biology and Molecular Genetics

Ms. Nakandala N.D.U.S	NIFS Research Assistant Gr. II
Ms. Perera U.M.P.K.	NIFS Research Assistant Gr. II
Ms. Cabral de Mel L.S.J.	Grant Research Assistant

Primate Biology

Ms Tharangi Hettiarachchi	Volunteer Research Assistant

Water Research

Ms. Bandara P.M.C.J.	NIFS Research Assistant Gr. II (from 01/12/2020)
Ms. Halpegama J U	Grant Research Assistant (From 16/10/2018)
Ms..Jayawardhene G.G.D.P	Grant Research Assistant (11/09/2020)
Ms. Rukshangani P.	Grant Research Assistant
Ms. Thilakarathne L.M.	Grant Research Assistant (11/09/2020)

Technical staff attached to Research Projects

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
Mr. Opatha S.	Chief Technical Officer (up to 2/11/2020)
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. Liyanage D.M.A.D.E.	Management Assistant Gr. III
Ms. K.B.J.B.K. Bandara	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
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
Ms. Weerasooriya R.P.M.	Senior Staff Assistant- Clerical
Ms. Illangakoon C.L.S.	Senior Staff Assistant- Stenographer
Ms. Ranasinghe C.	Senior Staff Assistant- Receptionist
Mr. Gunathilake D.G.	Record Keeper- Special grade
Mr. Gunathilake A.G.S.T.	Management Assistant Gr. III
Mr. Somananda M.A.G.	Driver- Special Grade
Mr. Gunasekara K.G.T.B.	Driver- Special Grade
Mr. Jayasinghe H.A.D.N.	Driver Gr. III
Mr. Dissanayake D.M.D.B.	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

Internal Audit Division

Mr. Wijesinghe W.M.I.U.B.	Internal Audit Officer (Up to 26/2/2020)

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
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

Rhizobium project Staff

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

Other grant staff

Ms. H.M.T.C. Heenkenda	Technical Assistant (from 01/11/2020)

ANNUAL **RESEARCH REVIEW**

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அடிப்படைக் கற்கைகளுக்கான தேசிய நிறுவகம்
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