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அடிப்படைக் கற்கைகளுக்கான தேசிய நிறுவகம்  
**NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES**



වාර්ෂික වාර්තාව  
வருடாந்த அறிக்கை  
**ANNUAL REPORT**  
**2019**

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மாநில திறன் மேம்பாடு, தொழிற்கல்வி, ஆராய்ச்சி மற்றும் கண்டுபிடிப்புகள் அமைச்சகம்  
State Ministry of Skills Development, Vocational Education, Research & Innovation



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**Ministry of Science, Technology & Research**

**National Institute of Fundamental Studies**



**ANNUAL REPORT**

**2019**

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**\*\* Please consider the English Medium document as the Main Report, since the working medium of the Institute is English Language**

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## 1. INTRODUCTION

# National Institute of Fundamental Studies

## Vision

“To be a world-renowned center of excellence for research in fundamental studies.”

## Mission

“Initiate, promote and engage in advanced research in fundamental studies for the enhancement of scientific knowledge, human resources, and national development”



## Director's Message

In 1981, the National Institute of Fundamental Studies was established with the vision of being a centre of excellence in basic research. Currently, we are engaged in a range of research programs which has a direct benefit to Sri Lanka sustainable development. In addition, we train (postgraduate students; Ph.D. and MPhil) that requires to support the R&D and industrial needs of the country. These targets were achieved with the help of our core research team who have a solid reputation in their respective fields.

All of our Institute's programs focus on three major aims: finding solutions to major national problems through basic research; training high - quality post - graduate students that this country needs for sustainable development and promoting science education in the country so more students are attracted to a career in science and thus utilize their skills for national development. NIFS has trained more than 1500 postgraduate students in the last 40 years and most of them are in very senior positions in the country. Through this we were also able to minimize brain drain from the country.

The National Institute of Fundamental Studies is well on its way in becoming the centre of excellence for basic research required by the country to resolve major national issues. We will also continue to produce high-quality graduate students that the country needs to improve the science and technology sector and economic sustainability.

**Prof. Saman Seneweera,**

**Director,  
(Chief Executive officer/Chief Finance officer)  
National Institute of Fundamental Studies**

## **OBJECTIVES OF THE INSTITUTION**

- ❖ Initiate, promote and conduct research and original investigations in fundamental studies in general with particular emphasis on mathematics, physical and chemical sciences, life sciences, social sciences and philosophy, taken in the broadest sense; to collaborate with public and private institutions as may be necessary to develop applications relevant to the studies conducted.
- ❖ Arrange lectures, meetings, seminars, and symposia in pursuance of its research work and for the diffusion of scientific knowledge;
- ❖ Invite scientists in Sri Lanka and from abroad, who are actively engaged in creative work to deliver lectures and participate in its research activities;
- ❖ Establish and maintain liaison with scientific workers and scientific institutions in other countries and promote international co-operation in matters relating to the aims and objects of the Institute, while taking care to protect and promote the national interest;
- ❖ Provide training, guidance, and assistance for research leading to the award of post graduate degrees by institutions recognized by the University Grant commission established by the University Act, No.16 of 1978.
- ❖ Do such other acts and things as may be necessary to promote the aims and objectives of the Institute.

The institutional research objectives were met through six research units under 19 research projects mentioned below and the technical and administrative staff ensured the smooth operation of the Institute.

### **RESEARCH UNITS**

#### **ENERGY & ADVANCED MATERIALS RESEARCH UNIT**

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

#### **THEORETICAL PHYSICS & COMPUTATIONAL STUDIES RESEARCH UNIT**

Quantum Physics & Applied Electronics research project

#### **NATURAL PRODUCT & FOOD CHEMISTRY RESEARCH UNIT**

Food Chemistry research project  
Natural Products research project  
Nutritional Biochemistry research project

**MICROBIOLOGY & CARBON SEQUESTRATION RESEARCH UNIT**

Bioenergy & Soil Ecosystems research project  
Rhizobium Project research project  
Microbial Biotechnology research project

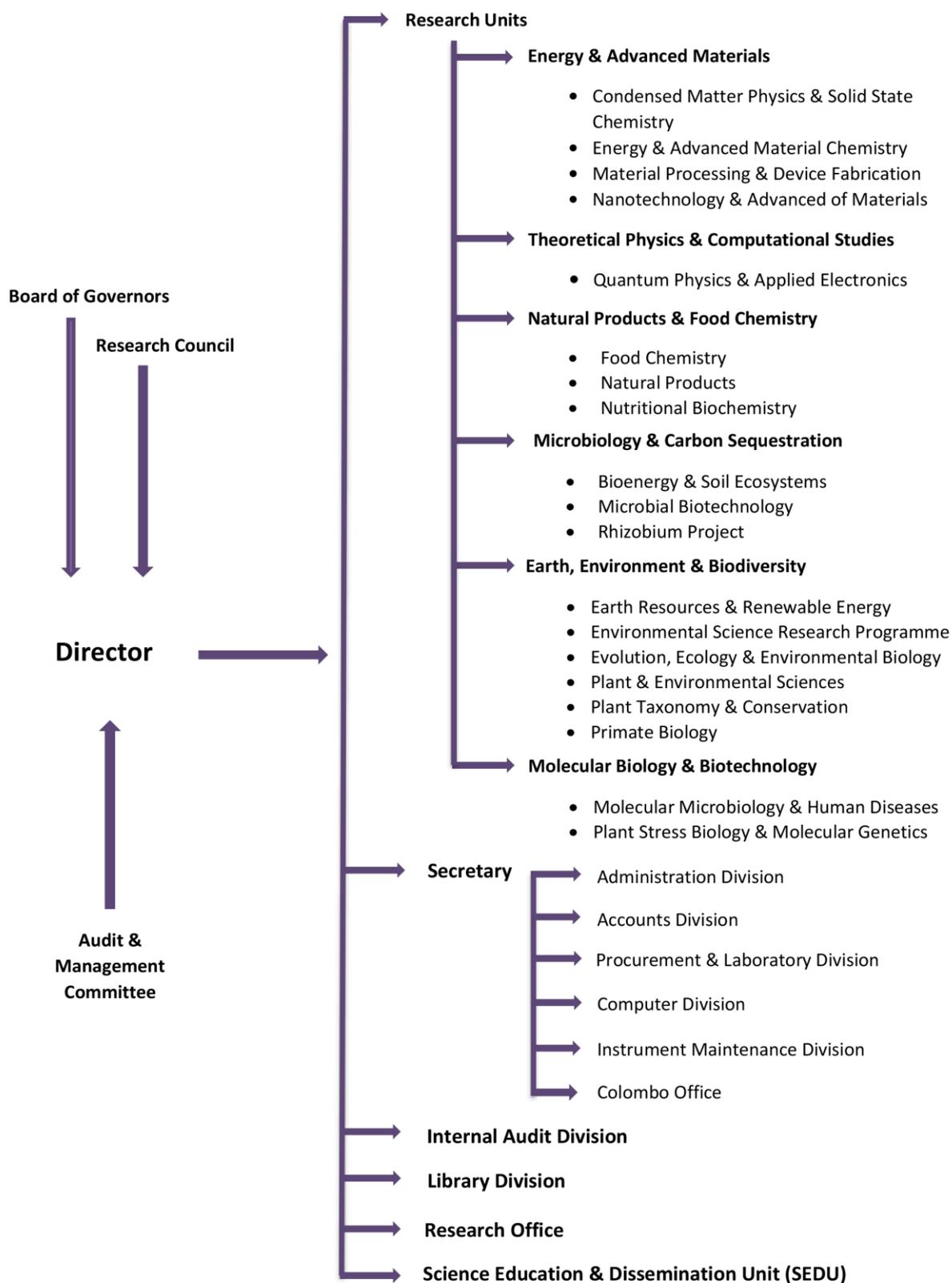
**EARTH, ENVIRONMENT & BIODIVERSITY RESEARCH UNIT**

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

**MOLECULAR BIOLOGY & BIOTECHNOLOGYRESEARCH UNIT**

Molecular Microbiology & Human Diseases research project  
Plant Stress Biology & Molecular Genetics research project

## 2. NIFS ORGANIZATIONAL CHART



### 3. BOARD OF GOVERNORS 2019

NIFS is administered by a twelve-member Board of Governors including Prof. Janaka Bandara Ekanayake, as the Chairman.

#### Chairman -Appointed by H.E the President

- **Prof. Janaka Bandara Ekanayake**, Department of Electronic and Electrical Engineering Faculty of Engineering/ University of Peradeniya

#### Members

##### *Ex-Officio members*

- The Advisor to the President on Scientific Affairs
- **Prof. Mohan De Silva**, Chairman/ University Grants Commission
- **Prof. Saman Seneweera**, Director/ NIFS

##### *Appointed by H.E the President*

- **Prof. Sarath G. Ilangantileke**, Independent Consultant on Post Harvest technology of Food Crops
- **Prof. Missaka P.B. Wijayagunawardane**, Department of Animal Science/ University of Peradeniya
- **Dr. Ravi Weerakoon**, Consultant Anesthetist Teaching hospital. Kandy

##### *Appointed by the Minister*

- **Prof. Upul B. Dissanayake**, Vice Chancellor of University of Peradeniya
- **Dr. A.D. Dharmapala**, Department of surgery/ University of Peradeniya

##### *Elected by the Research Council*

- **Prof. Namal Priyantha**, Department of Chemistry, University of Peradeniya
- **Prof. M.C.M. Iqbal**, Associate Research Professor/ NIFS

##### *Appointed by the Treasury*

- **Mr. J.M.U.P. Jayamaha**, Additional Director General/ Dept. of Public Enterprises, Ministry of Finance

#### Secretary to the Board of Governors/ NIFS

- **Dr. P.S.B. Wanduragala**

## 4. RESEARCH COUNCIL 2019

Research Council whose membership comprises university academics and researchers of the NIFS, served as an advisory body.

### Chairman

- Prof. Saman Seneweera, Director/ NIFS

### Members

#### *Appointed by H.E the President*

- Prof. D.M.D. Yakandawala, Department of Botany, Faculty of Science, University of Peradeniya
- Prof. Ruwan Duminda Jayasinghe, Faculty of Dental Studies, University of Peradeniya

#### *Nominated by the University Grant Commission*

- Prof. H.M.D. Namal Priyantha, Department of Chemistry, Faculty of Science, University of Peradeniya
- Prof. R.L. Chandrajith, Department of Geology, Faculty of Science, University of Peradeniya
- Prof. G.K.R. Senadeera, Department of Physics, The Open University of Sri Lanka
- Prof. L.R. Jayasekara, Department of Botany, Faculty of Science, University of Kelaniya

#### *Ex-Officio:*

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

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

#### *Elected by the Research Fellows of National Institute of Fundamental Studies*

- Dr. H.W.M.A.C. Wijayasinghe
- Dr. R. Liyanage
- Dr. I.P.L. Jayaratne

### Secretary to the Research Council

- Dr. P.S.B. Wanduragala

## 5. AUDIT & MANAGEMENT COMMITTEE 2019

### Committee Members

1. Mr. J. M. U. P. Jayamaha (Chairman)  
(Treasury Representative)  
Additional Director General  
Department of Public Enterprises  
Ministry of Finance  
The Secretariat  
Colombo 01
2. Prof. Sarath G. Ilangatilake (Board Member)  
1/53, Victoria Range Bungalows  
Kengalla
3. Prof. Missaka P. B. Wijayagunawardane (Board Member)  
No. 118, George E de Silva Mawatha  
Kandy
4. Prof. M.C.M. Iqbal (Board Member)  
Research Professor  
National Institute of Fundamental Studies  
Hanthana Road  
Kandy

### Secretary to the Committee (Convener)

5. Dr. P. S. B. Wanduragala (Secretary to the Board)  
National Institute of Fundamental Studies  
Kandy

### Observers

6. Mr. S. W. D. N. Wickramasinghe  
Audit Superintendent  
National Audit Sub Office  
University of Peradeniya  
Peradeniya
7. Mrs. H. D. Anuruddhika  
Chief Internal Auditor  
Ministry of Science, Technology and Research  
3<sup>rd</sup> floor  
Sethsiripaya Stage One  
Baththaramulla

**By invitation**

8. Prof. Saman Seneweera (Board Member)  
Director / CEO / CFO  
National Institute of Fundamental Studies  
Kandy
9. Mrs. P. S. S. Samarakkody  
Accountant  
National Institute of Fundamental Studies  
Kandy

**Assisted by**

10. Mr. Indika Wijesinghe  
Internal Audit Officer  
National Institute of Fundamental Studies  
Kandy

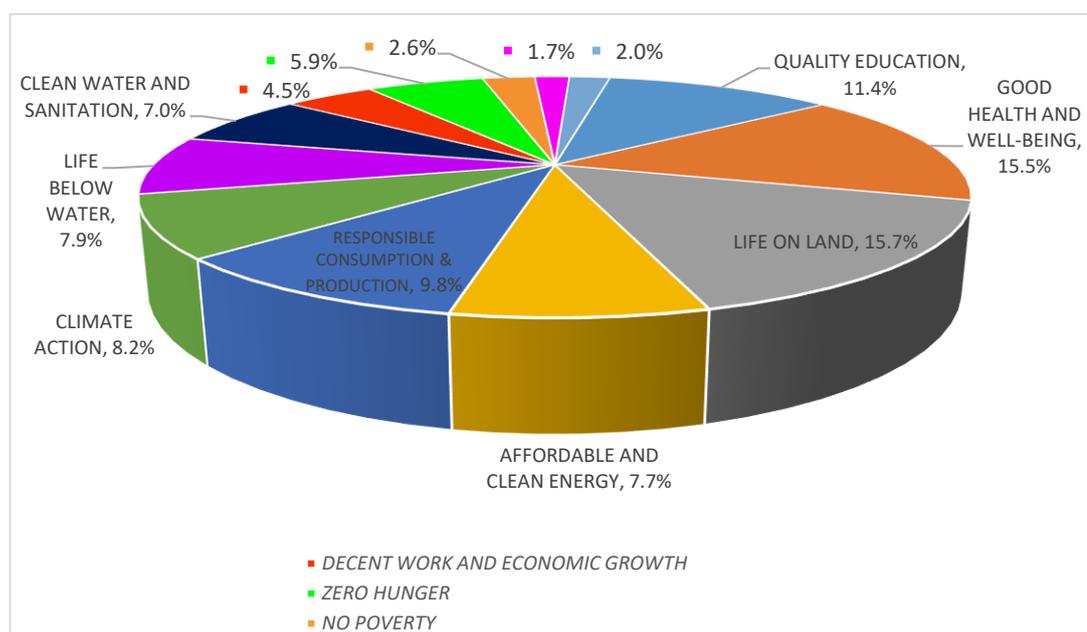
## 6. DIRECTOR'S REVIEW 2019

We are a national institute mandated to conduct fundamental research to advance scientific knowledge and find solutions to burning national problems. Despite the challenges we have faced in the past year, we have made a tremendous progress in our research outcomes, institutional development and knowledge dissemination while engaging in important national programs.

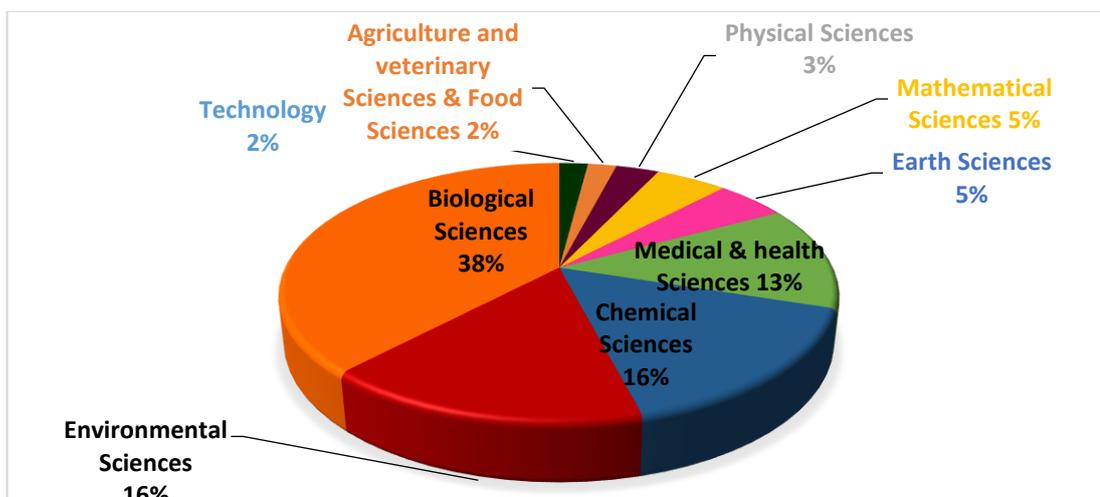
Last year alone, our scientists published over 75 research papers in international and local journals. In addition, 145 research articles were published as conference proceedings and abstracts. They have also attracted funding to the tune of Rs. 19 million and formed 55 strong research collaborations and networks both nationally and internationally.

Even though, NIFS gives prominence to basic/fundamental research in line with its act, our research work aligns with the UN Sustainable Development Goals.

Achieving Sustainable Development Goals (SDGs) the UN in Percentage form is given below;



**Figure 1. Achieving Sustainable Development Goals (SDGs) in 2019**



**Figure 2. Field of Research areas covered based on UN categorization in 2019**

The financial progress of the recurrent and capital expenditure incurred during year 2019 is indicated below. Accordingly, out of recurrent expenditure, 69% of total expenditure was made to meet the personal emoluments and the balance was made to meet the other expenses. Out of the capital expenditure, 44% was incurred to meet laboratory equipment and balance was expended to meet the other capital expenses.

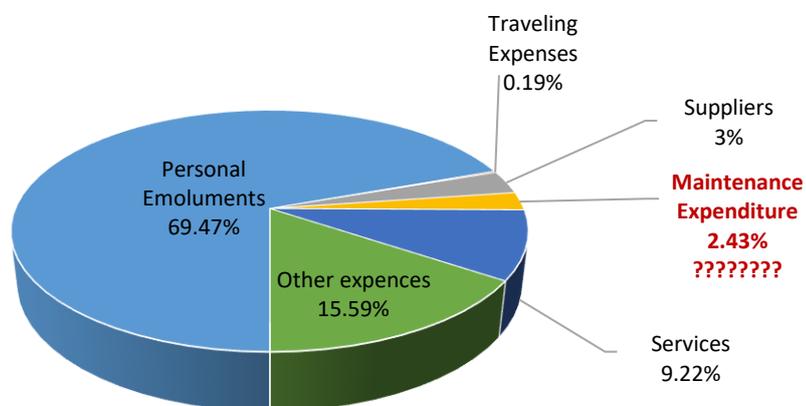


Figure 3. Details of the recurrent expenditure in year 2018

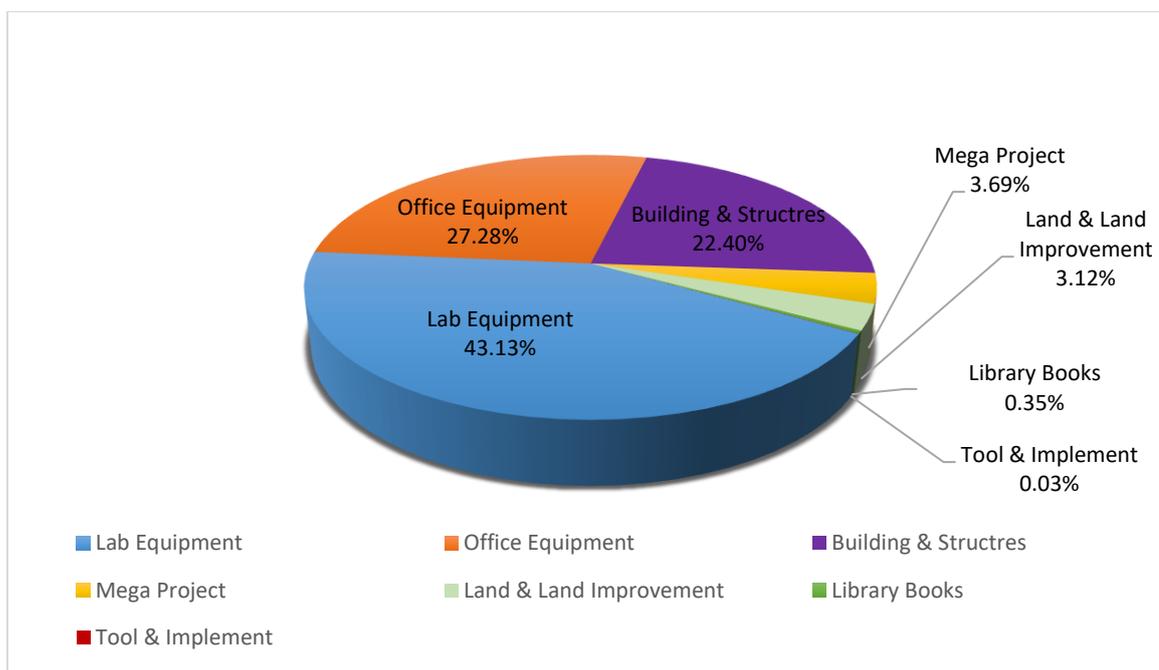


Figure 4. Details of the capital expenditure in year 2019

Currently, our Institute is equipped with state-of-the-art facilities for advanced research. All research activities are led by an internationally qualified expert pool of scientists. For the first time, we have also appointed on visiting basis 18 adjunct professors to NIFS from across the world, and they work with NIFS scientists to find solutions to broad scientific problems. Our motto is: even with limited facilities, produce the highest quality research outputs, gain international recognition and inspire the whole nation by developing the country economically and socially.

One of the core objectives of the NIFS is to train high-quality postgraduate students to contribute to national development. Over the past 40 years, we have trained about 1,500 high-quality M.Phil. and Ph.D. level postgraduates; Through this process, we have minimized the brain drain and lifted the academic vigor of our national universities. Presently, we are closely working with the Ministry of Higher Education, Technology and Innovation to establish the first NIFS affiliated graduate school in the country. This ties in with one of our core objectives: to train postgraduates within the country to a standard commensurate with training given in any world class institution. Presently, there are about 20 Ph.D., 50 M.Phil., 10 Masters and 45 undergraduate students undergoing training at NIFS.

NIFS is also extensively involved in science dissemination among school students, by conducting the School Science Program - one of the oldest programs in the country, and we continue to strengthen the program to meet the needs of budding scientists in the country. During 2019, we also extended our dissemination activities to the general public through our participation in three national Science, Technology and Innovation exhibitions and the first Open Day.

The projects conducted by our research scientists are primarily focused on addressing burning national issues like, COVID-19, human-animal conflicts, chronic kidney disease, food and nutrient security, water quality, natural resources and renewable energy, while generating fundamental knowledge that is required to address these issues. NIFS is on a fascinating path of growth and development in the coming years.

## 7. SUMMARY OF THE PERFORMANCES OF INSTITUTE IN THE YEAR 2019

### 7.1 Scientific achievements

- For the NIFS, according to the Act, it is mandatory, and important to publish the research findings in high quality indexed research journals. In the year, 2019 the institute has published articles in;
  - 25 research papers in Science Citation Indexed (SCI) journals
  - 33 research papers in Science Citation Expanded (SCI) journals
  - 19 research papers in other refereed journals
- In addition, 140 research articles were published as conference proceedings and abstracts. In addition, six books/Monographs & Book Chapters were published. Furthermore, 05 articles were published in magazines & newspapers to disseminate the details of the scientific findings to the general public.
- Scientists were capable of attracting funds for their research projects; 12-new grants & 33 ongoing grants
- We have 55 research collaborations out of which 04 were initiated in the year 2019. Details of the Research collaborations with universities & institutions

#### ***Australia***

- Queensland University of Technology
- University of New England
- University of Western Sydney
- Western Sydney University

#### ***Bangladesh***

- GonoBishwabidyalay (University), Savar, Dhaka

#### ***Canada***

- Dalhousie University,
- University of Guelph, Canada.

#### ***Germany***

- Georg-August-Universität Göttingen, Göttingen,
- Zoological Research Museum Alexander Koenig (ZFMK)

#### ***Italy***

- University of Parma

#### ***Japan***

- Shizuoka University, Japan

#### ***Norway***

- Western Norway University

#### ***Pakistan***

- University of Agriculture, Pakistan
- National University of Medical Sciences Rawalpindi, Pakistan

#### ***Sri Lanka***

- Open University of Sri Lanka, Nawala
- Sabaragamuwa University of Sri Lanka
- South Eastern University of Sri Lanka
- University of Colombo
- University of Jaffna

-

- University of Kelaniya,
- University of Peradeniya,
- University of Rajarata
- University of Ruhuna
- University of Sri Jayawardenapura
- University of Uva Wellassa
- University of Wayamba
- Atomic Energy Board, Sri Lanka
- Aquinas University College
- Coconut Research Institute, Lunuwila
- National Herbarium, Peradeniya
- Respiratory disease treatment unit, Teaching hospital, Kandy

***Sweden***

- Chalmers University
- University of Gothenburg

***United Kingdom***

- University of the West of Scotland
- Natural History Museum, London
- Buckingham Centre for Astrobiology, Buckingham
- University of Aberdeen, UK

***United State of America***

- Georgia State University, USA
- California Polytechnic State University, San Luis Obispo

- Research Supervision enhance the science knowledge hub and this capacity building process save millions of rupees which would have been spent overseas for postgraduate studies.

| Degree                | completed | in progress |
|-----------------------|-----------|-------------|
| PhD                   | 5         | 15          |
| MPhil                 | 7         | 49          |
| MSc                   | 1         | 10          |
| B Sc research project | 12        | 36          |

## **7.2 Progress of Research Projects**

### **7.2.1. Bioenergy & Soil Ecosystems research project**

*Project Leader –Dr. Renuka Ratnayake*

#### **Introduction to Research Project**

Global warming has come to its injurious level that a thriving need lies in mitigating the Carbon dioxide build up at the atmosphere. Soil Carbon sequestration is the process of removing atmospheric CO<sub>2</sub> via plant photosynthesis; the atmospheric CO<sub>2</sub> is captured and diverted to soil as soil organic carbon where it's become stable for thousands of years. Soils contain more carbon than all terrestrial vegetation and the atmosphere combined and is one of the most active carbon sinks on Earth, second only to oceans. 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 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 enzymes with high cost. 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.

#### **Activities carried out during the year**

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

Microbial cellulases: application in biofuel production and other value-added products and processes. Development of baseline soil information system for soil Carbon and other nutrients for paddy growing soils in Sri Lanka. Carbon Stock in Mangrove and Salt Marsh Ecosystems of the Gulf of Mannar Region of Sri Lanka.

#### **Overall performance of the Project**

We published the first digital soil C map for a forest in Sri Lanka. GIS based map has been prepared to show the distribution of soil C and other nutrients in Knuckles forest region. Nine agricultural land uses in Northern Sri Lanka has been covered for soil fertility parameters. This is the first detail soil survey conducted in the Northern part of Sri Lanka after 1987.

## 7.2.2. Condensed Matter Physics & Solid State Chemistry research project

*Project Leader – Prof. M.A.K. Lakshman Dissanayake*

### **Introduction to Research Project**

Condensed Matter Physics & Solid State Chemistry project at NIFS during the year 2019 focused on the synthesis and characterization of technologically important novel solid state and quasi-solid state (gel) materials for energy generation and utilization. During this period, the group has carried out several sub-projects on developing efficiency enhanced dye sensitized solar cells by (a) Enhancing the photocurrent by plasmonic effect using silver nanoparticles, (b) nano-structural modifications to titanium dioxide (TiO<sub>2</sub>) photoanodes, and (c) Studying the effect of polyaniline on the performance of dye sensitized solar cells fabricated with poly(ethylene oxide) based gel polymer electrolytes.

### **Activities carried out during the year 2019**

During 2019, three research projects on efficiency enhancement in dye sensitized solar cells have been completed successfully by our group.

- Ag colloidal nanoparticle-incorporated plasmonic TiO<sub>2</sub> (nanofiber/nanoparticle) double-layer electrodes for Quantum dot sensitized solar cells.

The overall efficiency and short-circuit current density of the plasmonic QDSSC are enhanced by 15% and 23%, respectively, with respect to the QDSSC without Ag nanoparticles. The enhanced performance of the plasmonic QDSSC is evidently due to the enhanced optical absorption by localized surface Plasmon resonance effect by the Ag nanoparticles in the TiO<sub>2</sub> double layer photoanode and the resulting increase in the short-circuit photocurrent.

- Hierarchically structured TiO<sub>2</sub> microspheres (MS) for efficiency enhancement in Dye Sensitized Solar cells.

TiO<sub>2</sub> P25/ TiO<sub>2</sub> MS based DSSC delivered a highest short circuit current density of 14.80 mAcm<sup>-2</sup> with an efficiency of 7.38%, while the efficiency of DSSC fabricated without a scattering layer showed only 6.68% efficiency. The efficiency enhancement is largely due to the improved photon absorption facilitated by superior light scattering as well as higher dye loading by TiO<sub>2</sub> microspheres.

- Effect of polyaniline on the performance of dye sensitized solar cells fabricated with poly(ethylene oxide) based gel polymer electrolytes.

The DSSCs fabricated with 1.5% PANI incorporated polymer electrolyte showed an efficiency of 6.56% while the DSSCs without PANI in the electrolytes showed an efficiency of 5.00% under the illumination of 100 mW cm<sup>-2</sup> (AM 1.5) simulated sunlight.

### **Overall performance of the Project**

All our projects were focused on developing low cost and high efficiency dye sensitized solar cells in order to fabricate solar panels which can be used to provide solar electricity at affordable prices to the industries and households in Sri Lanka. These solar cells are still in their research stage and it will take a couple of more years for them to be developed as proto-type solar panels to produce electricity. These are in line with the renewable energy policy of the government.

### **7.2.3. Earth Resources and Renewable Energy research project**

*Project Leader- Prof. N.D. Subasinghe*

#### **Introduction to Research Project**

Main aims of the ER & RE project are to find and develop new energy and earth resources as well as to improve the efficiency of selected existing resources. Sustainable utilization of known mineral deposits as well as finding hitherto unknown deposits will contribute to the economic development of the country. Understanding the nature of mineral resources and rocks as well as the geothermal resources in Sri Lanka will shed more light on the origin of lithological zones of Sri Lanka. Mapping natural radon levels and evaluation of mineral resources, with a focus on their origin and economic potential are also carried out as sub projects.

A pioneering research project on Thermoelectricity focusses on generating electricity directly from heat, as well as to increase the overall efficiency of an existing system by 'scavenging' and converting waste heat to electricity through co-generation.

**Evaluating geothermal resources:** Field work was carried out in selected areas to collect subsurface information using geophysical methods.

Resistivity (2-D profiling) and magnetic surveys were carried out around Nelumwewa and Mahapelessa areas, mainly to understand near-surface features. In addition, previously collected magnetotelluric and TDEM data were processed, inverted and interpreted to get information on deeper structures. This information will help to understand the origin of geothermal springs and evaluate their potential for development.

**Exploring new earth resources & understanding existing ones:** A large number of rock and mineral samples were collected around the country and analyzed to understand their mineralogy, mineral reactions and possible origin. Petrological analyses were mainly carried out using optical microscopes. Mineralogical and geochemical analyses were also carried out.

**Development of new low-cost thermoelectric material and modules:** Experiments were conducted to develop thermoelectric material using products based on Sri Lankan graphite. Thermoelectric materials can convert heat into electricity without any intermediate stages. Graphene oxide and reduced graphene oxides were successfully used as thermoelectric material

Developing renewable energy sources and improving the efficiency of energy use are imperative to save energy as well as the environment.

Thermoelectric generators can convert any type of heat, especially waste heat into useful electricity. Production of thermoelectric material from low-cost, locally available mineral (Sri Lankan graphite) was attempted and the results are promising.

A low-cost thermoelectric module capable of charging mobile phone using a candle or oil lamp was developed. This can be used as an emergency power-on-demand device, or in outdoors where no other charging source available.

## **7.2.4. Energy & Advanced Material Chemistry research project**

*Project Leader – J. Bandara*

### **Introduction to Research Project**

The main objective of the Energy & Advanced Material Chemistry project is to carry out 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. In the photocatalysis project, we construct 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. Our research is mainly focused on the production of hydrogen by water splitting reaction where hydrogen is considered to be the future energy source. 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<sub>2</sub> into useful chemicals? Additionally, the group is actively carrying out research on environment remediation where we investigate novel low-cost water and air purification methods for abatement of industrial pollutants by using sunlight.

### **Activities carried out during the year**

Hydrogen production by Photocatalytic water splitting is considered as one of the most important renewable paths but a reliable hydrogen production system yet to be achieved. The biggest problems encountered in photocatalytic water splitting systems are that poor response of the most of the stable photocatalysts to visible light and it is challenging to achieve an efficient separation of excited charge carriers, i.e. electrons and holes. Introducing of defects in high bandgap materials is one of the promising strategies to simultaneously tailor the band gap and control the life time of photoexcited electron-hole pairs. A strategy was developed to induce oxygen vacancy defects in SrTiO<sub>3</sub> powders *via* the reaction of NaBH<sub>4</sub> at high temperature (550°C) in the presence of a mixture of Ar:H<sub>2</sub> gases. The high temperature treatment of SrTiO<sub>3</sub> powders resulted in electron doping of SrTiO<sub>3</sub> due to oxygen vacancies triggers the development of a highly visible active SrTiO<sub>3</sub> photocatalyst with a remarkable 10-fold enhancement of H<sub>2</sub> evolution activity. In highly reduced SrTiO<sub>3</sub>, deeply trapped states are filled by electrons *via* reduction treatment (or electron doping) and the findings can be easily adapted to other high-band gap semiconductors to enhance the visible light photocatalytic H<sub>2</sub> generation reaction.

Thin-film solar cells technology is one of the solutions for expensive silicon solar cells. Antimony sulfide (Sb<sub>2</sub>S<sub>3</sub>) solar cells have demonstrated an efficiency exceeding 7% with a liquid electrolyte when assembled in an extremely thin absorber configuration deposited via chemical bath deposition. We developed solid type Sb<sub>2</sub>S<sub>3</sub> solar cells with P3HT as hole conductor material. The efficiency of the Sb<sub>2</sub>S<sub>3</sub>/P3HT based solar cell is ~4.0% and exhibit high stability under ambient conditions. Investigations are being carried out to enhance the solar cell efficiency of these solid state solar cells.

### **Developed Solutions to address current issues in the country**

We have developed a laboratory scale reactor for the treatment of waste water of service station and the laboratory scale reactor was further developed and scaled up

to treat the waste water in service stations. Trials will be carried out in coming months.

### **7.2.5. Environmental Science Research Programme**

#### **A. NIFS Water Research Project**

*Project Leader – Professor Rohan Weerasooriya*

##### **Introduction to Research Project**

Most researchers often consider environmental science as an applied discipline. At what underlying fundamental level of understanding does environmental research need to attain to evaluate the delicate processes that control nature? The NIFS Environmental Science Research Program is formulated on molecular level addressing of hitherto date unsolved Sri Lankan environmental problems that have no or ambiguous solution in the world. The NIFS Environmental Science Program Water Research Group focuses on the atmospheric, water, and soil ecological processes and to elucidate intrinsic factors that control water quality. During the year 2020, the researchers from national, regional and international laboratories collaborate to unravel the mystifying behaviour of natural water quality.

##### **Activities carried out during the year**

**Electrodialysis reversal (EDR)** process contains a frequent reversal of the direction of applying DC potential to their electrodes. This step added as an extension to typical electrodialysis (ED) systems to address fouling phenomena observed in ion-exchange membranes (IEMs) by performing a "self-cleaning" mechanism. However, membrane fouling in IEMs is still challenging to EDR based desalination applications regardless of its "self-cleaning" mechanism. The aim is to assess the suitability of the method to remove salinity and hardness from 37 locations of the dry zone. A membrane-based method based in our laboratory will use as the reference for efficiency assessments. Additionally, anode materials required for the EDR process will develop using Sri Lanka vein graphite as a starting material. Within the year, the modified EDR system will operate at a laboratory scale.

**Electrochemical sensor development:** We will synthesize three-dimensional reduced graphene oxide with varying degree of wrinkles and folds. The morphology of the reduced graphene will also be engineered by an etching to reduce self-aggregation. The properties of the graphene with different etching will also be characterized. Modified glassy carbon electrodes will develop using new materials for rapid detection of toxic metal ions by in situ electrochemical methods. In separate work, the nitrogen-doping graphene (N-rGO) will be synthesized by one-pot facile hydrothermal method for electrochemical detection of trace metal ions. Here, the nitrogen-rich urea will be selected as N precursor and intrinsically modified the electronic properties of graphene. The theoretical band structure, band gap and density of states (DOS) of graphene, rGO, N-rGO, and Hg(II) with N-rGO will be computed using Quantum Espresso (QE) (public domain code).

**New Proposals for Funding:** Kandy Lake Restoration and Kelniya River shed management proposals will formulate for funding. The Kelaniya River watershed proposal will submit collaboratively with the Adjunct Professor (Prof. Wei) for funding from China.

## B. Materials development & pollution remediation

*Project Leader – Dr. Lakmal Jayarathna*

### **Introduction to Research Project**

Environmental Science research program has been considered as an area of both basic and applied science. However, at NIFS it takes a different perspective in setting up environmental research programs. In essence the **NIFS Environmental Science Research Program** focused on addressing the fundamental scientific aspects of pressing environmental problems in Sri Lanka with global interest. Environmental pollution is one of the major results of modern development. Remediation of pollutant materials from water, soil and air is the most focused. Monitoring and understanding of the basic and fundamental mechanisms of the pollutant materials in nature is much more important. Advanced materials such as nanomaterials and composite materials play vital role in various applications.

Goals & Objectives of the project are development of smart nanomaterials for pollution control and remediation employing zeolites, composite materials, Sri Lankan vein graphite and solid wastes and value addition to local materials by converting it to high demanding end products. For that, under-utilized and cheaper raw materials, waste products utilized to develop new materials.

### **Activities carried out during the year**

#### **Activity I**

Synthesis of Nano- zeolite-A (LTA) with aid of SDS as particle size-controlling Agent

#### **Activity II**

Synthesis, characterization and determination of the catalytic activity of Fe and Cu modified zeolite **catalysts**.

#### **Activity III**

Zeolite based catalyst for NO<sub>x</sub>, SO<sub>x</sub> reduction

#### **Activity IV**

Surface modification of super-paramagnetic Magnetite nanoparticles for bio-conjugation

#### **Activity V**

Development of rapid lateral flow diagnostic kit for Dengue

Significant scientific research findings and inventions during 2019:

- Development of environmentally friendly method to synthesis nano zeolite.
- Method of lateral flow detection kit for dengue.

## C. Air Pollution & Risk assessment

*Project Leader- Dr. G. Bowatte*

Air pollution is a global public health issue. Annually about 7 million people die from air pollution exposure. It is 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 and whole population in a given areas is exposed. Therefore, even small increase may pose a high risk at the population level. Exposure

to air pollution leads to development and exacerbations of respiratory and cardiovascular diseases. The health burden pose on Sri Lankan economy by air pollution has significant consequences by affecting economic growth as well as welfare.

Air pollution modelling is used to estimate population/individual level exposures which are important in health risk assessments. Research project at the “Air Pollution Modelling and Health Risk Assessment” group 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, provide recommendations to implement policies to reduce pollution. The research of this group will provide evidence targeted at controlling air pollution by implementing policies.

### **7.2.6. Evolution, Ecology & Environmental Biology research project**

*Project Leader - Prof. Suresh P. Benjamin*

Studies in my lab are currently on plants and animals in terrestrial and freshwater ecosystems worldwide, with a special focus on the Western Ghats-Sri Lanka biodiversity hotspot. The primary focus, however, is the largely uncharted fields of invertebrate and small plant biodiversity. The invertebrate fauna of our country remains largely unexplored, with most studies originating during the colonial period.

#### **Activities carried out during the year**

- Molecular Phylogeny of Goblin Spiders with a Revision of Selected Genera (Araneae: Oonopidae) of Sri Lanka
- Molecular Phylogeny and Systematics of Jumping spiders (Araneae: Salticidae) from Sri Lanka

### **7.2.7. Food Chemistry research project**

*Project Leader – Prof. J.M. Nazrim Marikkar*

#### **Introduction to Research Project**

Food Chemistry project at NIFS focuses on exploring the application of food chemistry to add value to under-utilized plant resources to address food security. Food security is a problem of national importance for Sri Lanka in the context of climate change. In this backdrop, adding value to the under-utilized resources is a good strategy as Sri Lanka is a tropical country with a rich bio-diversity of plant resources.

#### **Activities carried out during the year**

Ms. S.S.K. Marasinghe, research assistant, participated and presented a paper at the International Tropical Agriculture Conference TROPAG 2019, Brisbane, Australia, 11-13<sup>th</sup> November 2019. She again participated and presented another paper at the International Conference on Agriculture and Food Security 2019, Colombo, Sri Lanka, 08-09<sup>th</sup> August 2019. She again made a presentation at the Young Scientists' Symposium of National Institute of Fundamental Studies, Kandy, Sri Lanka, 12<sup>th</sup> June 2019. Ms. Rasika Gunarathna, research assistant, participated and presented a paper at the *RESCON-2019* conference of PGIS, University of Peradeniya. Prof. Nazrim Marikkar participated as a resource person at the Stakeholders' Workshop for curriculum revision of BSc (Food Sci & Technol) program of University of Peradeniya.

In addition, he acted as a resource person and or a member of the scientific committee to review manuscripts submitted for several international scientific journals, Nutricon-2019 international conference, and RESCON-2019 conference of PGIS, University of Peradeniya.

Prof. Nazrim Marikkar and Ms. Rasika Gunarathna participated as a resource person in the Shilpasena Exhibition held from 26 – 29<sup>th</sup> September 2019.

#### **Developed Solutions to address current issues in the country**

During the year, research focus was given to utilization of coconut testa as a by-product generated from coconut processing industries in Sri Lanka. As wet coconut testa constitute around 18% of the kernel weight, an estimated 30,000 Kg of testa would be coming out of 100,000 nuts processed by the industries. Our studies showed that every 2.0 Kg of dried testa would generate about 900.0 g of flour. Hence, roughly, 6750 Kg of testa flour could be generated from 100,000 coconuts. In this way, by-product utilization would enhance the economic value of coconut.

### **7.2.8. Material Processing & Device Fabrication research project**

*Project Leader* – G. R. A. Kumara

#### **Introduction to Research Project**

This project is involved in basic study and experimentation in Material Processing and Device Fabrication with an emphasis on graphite, graphite-based devices, carbon supercapacitors and investigations related to solar cells and other electronic devices based on new materials primarily generated from local minerals. Work related to graphite including the exfoliation of graphite, its derivation into graphene plates and preparation of graphene thin films and their use in electronic devices is also conducted through this project. Furthermore, the project conducts research in the area of extremely thin absorber solar cells and the development of hole conducting materials used in these solar cell devices. The project is also involved with the conversion of waste materials, such as coconut shells, to highly porous and electronically conducting activated charcoal for versatile applications in electronic devices such as supercapacitors and counter electrodes of solar cells. Use of expanded graphite derived from Sri Lankan vein graphite is also tested in relation to water and air purification and cleaning of oil spills in water.

#### **Activities carried out during the year**

A simple procedure is discovered for producing high electrical conductivity and highly porous activated charcoal from coconut shells. This activated coconut shell charcoal was used for preparation of supercapacitor electrodes, which gave the capacitance elevated to the level of 175 F/g. Supercapacitor electrodes are usually fabricated using powdered activated charcoal and binder. We have replaced the synthesized binder with natural jack fruit latex, hence durability of capacitor was increased due to jack fruit latex binder insoluble in aqueous solution. Another application of this activated charcoal was depositing them on conducting tin oxide glass as a thin film, to be used as the counter electrode for dye-sensitized solar cells (DSCs). The efficiency of the solar cell 7.85% obtained exceeds, values obtained from other forms of activated carbon derived from bio-materials. Ability of using ionic liquids as solvents for

electrolytes in DSCs has been studied since low boiling points and high vapor pressures of organic solvents limit the long-term stability of DSCs. Another area of work has done by this period was fabrication of perovskite solar cells using CuI as hole transporting material which leads to obtain 8% efficiency with simple pressing method of CuI. Designed and developed a novel, low-cost, one-step method to recover waste graphite attached to wall rocks of graphite mines using a simple chemical solution and to convert the graphite powder thus obtained to super expanded graphite. We have developed a novel and innovative method to remove oil in oil spills and to recover the spilled oil using this super expanded graphite. Further, super expanded graphite derived from this process was used for the production of graphene.

### **Developed Solutions to address current issues in the country**

Oil spills are a world-wide problem and cleaning of oil spills involves tedious and expensive procedures. We initiative to commercialize the applications of super expanded graphite for spilled oil removal and electrode fabrication during this period. Electronically highly conducting and porous activated coconut shell charcoal was prepared by an innovative novel process which can be carried out in isolated domestic scale or in large industrial scale to convert and add a great value for the material to be used in electronic industries as well as in water and air purification. Usage of this waste product of coconut shells supporting the national effort of eradicating dengue and other mosquito-borne diseases.

## **7.2.9. Microbial Biotechnology research project**

*Project Leader – Prof. Gamini Seneviratne*

### **Introduction to Research Project**

For non-legumes like rice, maize, vegetables, tea etc., we invented Biofilm biofertilizers (BFBFs) in 2003. This was commercialized in 2014. For rice paddy, this was researched in collaboration with RRDI, Batalagoda, and first introduced to farmers' fields in 2015, and the product was commercialized in 2016 in small scale. Thus far, the effectiveness of BFBF has been proven over thousands of acres by reducing chemical fertilizers NPK used by the farmers up to 50%, while increasing paddy yields from 10-30%. In the future, this will save billions of rupees to the country by cutting down chemical fertilizer's imports, while also saving the health of people and the environment. This program is also in line with HE the President's concept of introducing organic and biofertilizers to agriculture in Sri Lanka.

### **Activities carried out during the year**

During 2019, we studied the effects of BFBF application on environmental and health aspects. In one study, paddy soil carbon sequestration (SCS) or storage with BFBF application was analyzed and compared with that of farmers' chemical fertilizers (CF) alone application in 25 representative locations in several districts of Sri Lanka throughout three consecutive seasons Yala 2018, Maha 2018/19 and Yala 2019. This is important for reducing atmospheric CO<sub>2</sub> content, which leads to mitigate global warming and climate change. Further, this can earn foreign exchange through carbon trading, i.e. highly CO<sub>2</sub> emitting industrialized countries pay to countries which store C through SCS in their soils. Interestingly, it was found that if we would convert total annual paddy cultivation of ca. 2.5 million acres from farmers' CF practice to BFBF

practice, we would be able to add another ca. 190 billion rupees to the country's economy in the next five years. A similar effect was observed in tea cultivation too. In another study, we developed a simple lab method to detect whether leafy vegetables are organic or not. Here, a simple lab culturing of leaf disks for microbial growth was used as an indicator to detect this.

#### **Developed Solutions to address current issues in the country:**

In 2019, the BFBF was introduced to 4,000 acres of rice cultivations in Hambantota, Polonnaruwa, Kurunegala, Ampara and Mahiyanganaya. This reduced CF use by farmers up to 50%, thus saving human health, economy and the environment.

Paddy SCS will address the issue of global warming and climate change.

### **7.2.10. Molecular Microbiology & Human Diseases research project**

*Project Leader – Prof. D. N. Magana-Arachchi*

#### **Introduction to Research Project**

Our research was focused on microbial ecology in different environments and the effect of microorganisms on human diseases. We concentrated on both communicable (CD) and non-communicable diseases (NCDs) that affect humans globally and nationally and tried to understand these scientific problems on a molecular microbiological scale.

#### **Activities carried out during the year**

The main six research activities of the year 2019 were, research on pulmonary diseases and microorganisms in which the study on role of lung microbiome in lung cancer and bronchiectasis patients was completed. The study on Genetic characterization of drug resistant *Mycobacterium tuberculosis* from Sri Lankan and Pakistani TB patients and identification of their associated biomarkers is in progress while the study on identifying *Mycobacterium tuberculosis* isolates belonging to the Beijing lineage from TB patients in Kandy, Sri Lanka was also completed. The other five research activities are study of diversity and distribution of thermophilic microorganisms in hot springs of Sri Lanka: A metagenomic approach, characterization of resistomes in selected environments of Sri Lanka, an epidemiological study on Asbestos related occupational health problems among asbestos industry workers in Sri Lanka, enrichment mechanism of CKDu-risk factors in ground water, their uptake pathways and potential remedies and to conduct balloon flights over Sri Lanka to detect possible ingress of cometary microorganisms & particulate matter.

- Findings of lung microbiome study revealed that *Corynebacterium tuberculostearicum* and *Keratinibaculum paraultunense* were present only in lung cancer patients which can be considered as markers for the particular disease.
- Study on Beijing Lineage *Mycobacterium tuberculosis* strains, revealed that 26% (95% CI: 18%-35%) TB patients were infected from Beijing Lineage. Prevalence of Beijing Lineage was significantly higher among those with high sputum smear grades (2+ and 3+), who travelled abroad and among young people who are less than 35 years.

- Study on impact of microbial air quality on paediatric respiratory health in Kandy, higher proportion of urban preschool children (57.97%), suffered from at least one respiratory disease (upper respiratory tract infections, rhinitis, wheeze, etc.) compared to rural preschoolers (31.17%). Additionally, inhalation dose rates were also high among urban preschool children, both indoor and outdoor ( $2.00 \times 10^4$  and  $1.05 \times 10^4$  cells/kg day).

### **7.2.11. Nanotechnology & Advanced Materials research project**

*Project Leader – Dr. A. Wijayasinghe*

#### **Introduction to Research Project**

Sri Lanka possess a large 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 these applications, is lacking. Therefore, this project highly emphasizes on performing fundamental, but target oriented, advanced scientific investigations through developing our mineral resources for those highly profitable technological applications. Investigation on novel advanced semiconductors for energy conversion and storage applications, mainly for novel rechargeable batteries, is another important research area carried out by this project. Under that, a number of research investigations are being performed to develop transition metal-based semiconductors by introducing modern nano technological techniques and processes.

#### **Activities carried out during the year**

*Development of low-cost and performance enhanced advanced materials for energy conversion using low-cost and nano material synthesis techniques:* In order to understand the mechanisms controlling the morphology and size of particles from micron to nano scales, the effect of the precursor on crystal growth in nano particle formation has been investigated under this sub-activity. Moreover, advanced fundamental scientific investigations have been carried out with an ultimate objective of developing performance enhanced transition metal semiconductors for the electrode application of electrochemical energy conversion

*Development of materials for the electrolyte and electrode applications in upcoming Na-ion and Mg-ion batteries:* Laboratory cells were tested with our developed Na-Ni-Mn-Co oxides doped with cheaper transition metals as the cathode material and our developed  $\text{Na}_2\text{Ti}_3\text{O}_7$  nano structured anode material. They revealed promising performance for the electrodes application in Na-ion rechargeable batteries.

*Electrochemical performance investigations of Li-ion rechargeable batteries:* Our investigations carried out on locally fabricating of full Li-ion rechargeable coin cell battery with developed Sri Lankan graphite as the anode material and our invented nanostructured transition metal oxides as cathode materials, resulted very promising performance with higher capacity, durability but importantly at a lower cost.

## Overall performance of the Project

“National Center for Advanced Battery Research (NCABR)” was established attached to our project at NIFS. This NCABR is a laboratory facility open for all research groups working in the country on developing local minerals for battery and energy related applications. Further investigations have been started to fabricate bigger battery types such as pouch cells.

### 7.2.12. Natural Products research project

Project Leader – Prof. U.L.B. Jayasinghe

#### Introduction to Research Project

The overall objective of the Natural Products Project of the NIFS is the identification of bioactive extracts and compounds from natural sources, as potential resources 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 found in tea, medicinal plants, edible fruits and spices using Liquid Chromatography - Mass Spectrometry (LC-MS) and also studies on the cause and control of postharvest fungal diseases, the Stem-end Browning and three physiological disorders, Fruit pitting, Lenticel Darkening and the Internal Pulp Browning of mango var. TomEJC in 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.

#### Activities carried out during the year

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) Study of the cause of management of postharvest diseases and disorders that adversely affect the export potential of mango var. TomEJC.

#### Chemistry and bioactivity of fungi associated with medicinal plants, edible fruits:

Currently we are studying the chemistry and bioactivity of secondary metabolites produced by the endophytic fungi isolated from some medicinal plants. Several secondary metabolites with interesting structural features and some useful bioactivities have been isolated.

Enzyme inhibitors from plants: Secondary metabolites isolated from *Myristica fragrans*, malabaricone C (**1**), 3-(3-methyl-5-pentyl-2-furanyl)-2(*E*)-propenoic acid (**2**), licarin A (**3**), maceneolignan B (**4**) and elemicin (**5**). Compound **1** showed the highest AChE inhibitory activity ( $IC_{50}$   $2.06 \pm 0.04$   $\mu\text{g/mL}$ ) and antioxidant activity ( $IC_{50}$   $6.56 \pm 0.02$   $\mu\text{g/mL}$ ) while compound **2** displayed the most potent  $\alpha$ -glucosidase inhibitory activity ( $IC_{50}$   $50.91 \pm 0.01$   $\mu\text{g/mL}$ ). This is the first report of  $\alpha$ -glucosidase inhibitory activity of **2**. Results indicate that the aril of *M. fragrans* showed good anticholinesterase and  $\alpha$ -glucosidase inhibitory activities and antioxidant effect *in-vitro* that have a potential to be use as the treatment of Alzheimer’s disease.

Fungal Metabolites: Secondary metabolites were isolated from an endophytic fungus *Biscogniauxia capnodes* and identified as Chromatographic separation of this extract

furnished 2 isocoumarins, reticulol (1) and 6-*O*-methyl-reticulol (2), and 2 dihydroisocoumarins, 5-methylmellein (3) and 7-hydroxy-5-methylmellein (4). Compound 1 showed moderate antioxidant activity against 2,2'-diphenyl-1-picrylhydrazyl radicals (IC<sub>50</sub> value, 58 µg/mL). This is the first report of the isolation of *B. capnodes* as an endophyte, as well as the compounds 1 to 4 from *B. capnodes*.

Postharvest diseases and disorders of mango var. TomEJC: Eight fungal pathogens associated with the Stem-end Browning (SEB) were isolated and identified, their pathogenicity was confirmed. Pre- and postharvest management practices were established and recommended. The cause of fruit pitting was shown to be a deficiency of elements through fruit tissue analyses by ICP. Addition of a supplementary fertilizer mixture reduced the incidence of fruit pitting below 1% which was recommended for pitting management. Lenticel Browning (LD) results from entry of excess water into lenticels and could be reduced by altering certain postharvest handling practices. Development of Internal Pulp Browning (IPB) was found to be related to some physiological and weather factors. The disorder could be prevented by alteration of fruit harvesting criteria.

#### **Overall performance of the Project**

- Continuing the of the identification of biological active extracts / compounds from Sri Lankan plant and fungal flora
- Complete understanding of the causes of a postharvest disease and three disorders and development of pre- and postharvest management practices. Overall, the outcome of the project significantly reduced the loss of good quality fruits to be harvested and postharvest losses and also increased the availability of exportable mango fruits.

#### **7.2.13. Nutritional Biochemistry research project**

*Project Leader –Dr. Ruvini Liyanage*

##### **Introduction to Research Project**

Nutritional Biochemistry project focuses on various aspects of functional and nutritional properties of foods and covers a wide area like functional and nutritional properties of food, food safety, and bioavailability of food to improve health and well-being of people. Findings would help to make healthy food choices, reduce disease and illness risks, and to gain knowledge of nutritional and functional properties of both utilized and underutilized foods.

##### **Activities carried out during the year**

In year 2019, Nutritional Biochemistry Project focused mainly on three projects as described below.

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. In addition, *in vivo* and cell culture studies are also done for further confirmation of functional properties. At present there are three ongoing studies such as assessing functional properties of some starches and commonly consumed Ayurvedic plants in Sri Lanka and investigating nutritional and physicochemical properties of raw and processed *Artocarpus nobilis* seeds native to Sri Lanka.

Bioavailability of food: Bioavailability is the degree to which food nutrients are available for absorption and utilization in the body. It is a critical issue for many nutritional concerns. In this study, bioavailability of nutrients and antioxidant compounds in legumes have been studied. Further, the effect of boiling and simulated digestion on prebiotic activity of legumes have been studied.

Effect of Biofilm-biofertilizer on nutritional and other functional properties of rice: Biofilm biofertilizer was developed at NIFS with the aim of reducing chemical fertilizer usage to minimize the environmental pollution and to reduce the cost of agriculture. Although this fertilizer has been introduced to various crops already the effect of this fertilizer on nutritional and functional properties of crop harvest have not been studied. Thus, in this study in collaboration biofilm biofertilizer (BFBF) project at NIFS, nutritional biochemistry project has been investigating the effect of BFBF on nutritional and biochemical properties of selected rice varieties grown in Sri Lanka.

#### **Developed Solutions to address current issues in the country**

All the above studies were conducted to find solutions for non-communicable diseases in Sri Lanka. Findings are useful to validate the health benefits and bioactive properties of Ayurvedic plants and to identify most suitable starch sources for diabetes. From the preliminary findings it was observed that there is a favorable effect of biofilm biofertilizer on nutritional and functional properties of rice varieties and this would be helpful in popularizing the usage of BFBFs in Agriculture.

#### **7.2.14. Plant & Environmental Sciences research project**

*Project Leader –Prof. M.C.M. Iqbal*

Our research is concerned with (i) Environmental Remediation of pollutants using plants and plant biomass, (ii) Synthesis of metal organic Frameworks (MOFs) to adsorb pollutants, (iii) Recycling phosphorous from waste water, and (iv) Micropropagation of tree species for Restoration of degraded dry forests.

Our researchers have identified the use of plant materials, and polymer-silicate materials to remove heavy metals and textile dyes from wastewater. A MOF was synthesized capable of converting carbon-dioxide gas (CO<sub>2</sub>) to useful organic compounds. To recover phosphorous from farm effluent water, aquatic plants were identified, which after absorption of phosphorous can be used as a bio-fertilizer.

To restore the degraded dry forests in Sri Lanka and restore the ecology, different applications of plant tissue culture technique in forest improvement were conducted. We developed experimental techniques such as organogenesis and embryogenesis with different plant parts to micropropagate the tree species (*Madhuca longifolia* and *Manilkara hexandra*). Plant micropropagation technique was applied on *Stevia rebaudiana*, a plant species identified as a non-caloric, zero glycemic alternative sweeteners. Due to its poor germination, tissue culture protocol was developed to produce a large number of plants with improved vegetative mass using Coconut water as low-cost natural media enhancer.

#### **Activities carried out during the year**

Submission of research articles, attending to national and international conferences, Conducting Lectures and practical sessions for GCE A/L students (Tissue culture), Training was conducted for potential entrepreneurs who wish to start new ventures

in plant tissue culture), Training and guiding undergraduates and participated in national exhibitions *Shilpa Sena*.

- Development of adsorbents to remove textile dyes and heavy metals.
- Identification of phosphate hyperaccumulators.
- Protocol development for mass propagation of *Stevia rebaudiana*.
- Publications in peer reviewed journals, conference abstracts and a book chapter.

### **7.2.15. Plant Stress Biology & Molecular Genetics research project**

*Project Leader –Prof. S. Seneweera*

#### **Introduction to Research Project**

##### Creating global benchmark yields in paddy and minor crops:

The current national average rice yield is close to 4.2 MT per hectare which increased from around 2 MT/HA in the 1970's to 4.2 MT/HA by the early 2000s. The current average yield remains stagnant despite 95 percent of Sri Lanka's rice crop extent being brought under improved cultivars. Traditional cross hybridization and selection is still a widely used strategy for developing cultivars with a higher yield in Sri Lanka. The already low yield potential of Sri Lankan rice is further challenged by the following factors; increase in the cost of production, and inevitable climate change. 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 still exists. The root cause for the low yield potential of Sri Lankan rice is the decades of negligence in the adaptation of new scientific technology in plant breeding. In the developed world, advanced plant breeding techniques like gene mapping, high throughput phenotyping, and gene editing based crop improvement are widely used, making significant progress in yield enhancement. However, in Sri Lanka, such genetic and molecular tools in plant breeding are not being used. In this project, we propose an innovative methodology to increase rice yield potential by designing a new ideotype. This will be achieved by identifying key physiological and biochemical traits associated with rice yield together with genome mapping and transcriptome comparison. The proposed study will adapt multidisciplinary sciences including transcriptomics, bioinformatics, biotechnology and plant physiology. The final objective is to generate fundamental knowledge to develop a new plant ideotype having high yielding potential and climate insensitivity, ultimately delivering greater socio-economic dividends.

##### Develop plant demand-based nitrogen fertilizer using hybrid nanomaterial:

Nitrogen (N) is the element that plants require in the highest quantity. Availability of N is one of the keys limiting factors in crop productivity in agricultural systems. Uptake, assimilation, translocation and remobilization are the main steps involved in the use of N by plants. Plant N uptake from the soil depends on environmental conditions, soil type and plant genotype. Approximately, 50-70% of N applied to the soil is lost, mainly due to surface run-off, leaching of nitrates and volatilization of ammonia. Extensive use of N fertilizers results in excessive emission of N<sub>2</sub>O, a major greenhouse gas that largely contributes to global warming. Therefore, one of the major research challenges today is to improve the nitrogen use efficiency of crop plants. Nanotechnology is being identified as a new avenue to improve nutrient use efficiency. Fertilizers can be designed in such a way that they release nutrients in a

controlled manner which synchronizes with the needs of plants. Therefore, we aim to develop an environmentally friendly, cost effective, biodegradable, controlled release nano fertilizer system with high nitrogen use efficiency.

#### **Activities carried out during the year**

##### Creating global benchmark yields in paddy and minor crops:

has obtained breeder seeds of 20 local rice varieties available in RRD1, Bathalagoda, 11 local rice varieties from Ambalanthota and Labuduwa, and 50 traditional varieties from PGRC and have initiated seed germination for multiplication process. Another 50 international cultivars have also been obtained to be utilized for this study. DNA has already been extracted from local rice varieties and all DNA will be subsequently genotyped using high-density rice array (HDRA) that consists of 700,000 SNPs to utilize them for high throughput genotyping. Association mapping will be employed to identify specific functional genetic variants linked to phenotypic differences in a trait to facilitate detection of trait causing DNA sequence polymorphisms. These genetic traits will be utilized to develop a rice ideotype having a higher yield potential.

##### Develop plant demand-based nitrogen fertilizer using hybrid nanomaterial:

We have synthesized 4 different types of nanoconjugates and characterized these materials using Fourier Transform Infrared Spectrometry (FTIR), particle size analysis (PSA), X-Ray diffraction and CHN Analysis. The testing of these materials with rice plants is under way.

### **7.2.16. Plant Taxonomy & Conservation research project**

*Project Leader - Prof. D.S.A. Wijesundara*

#### **Introduction to Research Project**

The Plant Taxonomy and Conservation project focusses primarily on,

- 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.

One of the main tasks of this project is to maintain and develop the NIFS-Popham Arboretum at Dambulla.

#### **Activities carried out during the year**

The woody vegetation of one third of the NIFS-Popham Arboretum was mapped on a GIS map. The research on restoration ecology and regeneration is continuing. The interpretative signage including maps and informative panels on both flora and fauna within the arboretum established. The foot bridges, camp site toilet and accommodation facilities were renovated.

A research project on factors affecting photosynthesis of trees at the NIFS-Popham arboretum conducted was initiated and the research activities on natural products from medicinal and invasive plants were carried out in collaboration with Universities of Peradeniya and Jayawardanapura.

During the field visits conducted, 30 species out of 31 recorded species of genus *Syzygium* in Sri Lanka were collected. The collection is included 250 specimens which

contained voucher specimens, DNA samples and reproductive material collected in FAA for dissection.

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.

#### **Developed Solutions to address current issues in the country**

- Several tree Species that can be used successfully in reforestation work in the dry zone were identified
- Some antifungal compounds were extracted from Invasive Alien Plant species
- Some extremely rare and endangered plant species were rediscovered and included in the National Red list

#### **7.2.17. Primate Biology research project**

*Project Leader –Prof. W. Dittus*

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. These 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 30 such documentaries have been produced, more are planned for the future. The films also 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 history. To this end we require large samples over an extended period to assure statistical soundness (longevity on wild monkeys may exceed 35 years).

#### **7.2.18. Quantum Physics & Applied Electronics research project**

*Project Leader –Prof. Asiri Nanayakkara*

##### **Introduction to Research Project**

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.

### **Activities carried out during the year**

During 2019 we continued carrying out several investigations with regards to quantum and classical correlations and periodic nature of quantum random walks.

In the paper (2010 Phys. Scr. T140 014035), Stefanek et al has proved that for any four-state quantum walk, there cannot be cycles longer than two steps. Our investigations revealed that they have not used the most general form of characteristic polynomials in their proof. Consequently, the result is not generally valid and hence there can be quantum walks having cycles longer than two steps.

### **7.2.19. Rhizobium research project**

*Project Leader –Prof. S. A. Kulasooriya*

#### **Introduction to Research Project**

Rhizobia are soil bacteria that form symbiotic root nodules with leguminous plants which enable them to fix atmospheric N<sub>2</sub> and provide it to host plants. In this project we isolate, screen and select efficient rhizobia, prepare inoculants with them and supply such inoculants to farmers to apply to legume crops. By inoculation we increase nodulation in the targeted host crops, increase their N<sub>2</sub> fixation and minimize the application of chemical N-fertilizers such as urea to them. In this manner we have so far been able to completely replace urea applications to soybean, mung bean, vegetable bean, groundnut, long bean and the fodder crop clover.

#### **Activities carried out during the year**

Development and distribution of rhizobial inoculants continued throughout the year. Demand for inoculants for vegetable beans increased. A chemical N-fertilizer response curve done in a field trial with vegetable bean (*Phaseolus vulgaris*) at Ankumbura confirmed that urea fertilizer can be replaced completely by inoculation. Assessment of weed growth in this experiment showed that a 60% reduction in weed biomass could be obtained by replacing urea application with rhizobial inoculation.

All the rhizobial strains used for field inoculation of different crop legumes were subjected to molecular characterization. Results showed ten clusters at 70 % molecular similarity coefficient and four clusters with 100 % similarity. Based upon the Maximum Likelihood tree search conducted using 16S rRNA gene sequences on the most commonly used 5 strains, isolates were identified as *Bradyrhizobium* sp. (Green Gram), *Rhizobium* sp. (Soybean, Vegetable bean and Clover) and *Sinorhizobium* sp. (Groundnut). This is the first record of *Sinorhizobium* in Sri Lanka.

Yet another study was done as a part of a M.Sc. research project by a student of the University of Peradeniya. This was on isolation of phosphate solubilizing microorganisms associated with legume plants and evaluating their P-solubilizing abilities using *Azolla* as a bioassay plant. Among 3 bacterial and 2 fungal isolates tested, best P-solubilization was obtained with the fungal isolate identified as an *Aspergillus* sp.

Extension work for demonstrating and popularizing rhizobial inoculation continued. Field trials were initiated to test the efficacy of rhizobial inoculation of groundnut in collaboration with officers of the Wayamba Provincial Agriculture Department.

#### **Overall performance of the Project**

- Continuous use of chemical fertilizers had not only become an economic burden to the country, but it also aggravates environmental pollution.

- By rhizobial inoculation it had been possible so far to do away with urea application to soybean, mung bean, vegetable bean and groundnut.
- This will minimize both the cost and environmental pollution in the cultivation of these crops without any reduction in crop yields.

### **7.2.20. Aversive Geofencing Technology to Mitigate Human-elephant Conflict**

*Project Leader –Prof. Saman Seneweera*

#### **Introduction to Research Project**

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 system 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 advance 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.

#### **Activities carried out during the year**

A National Research Council Grant was received in 2019 to carry out this project. The study is being conducted on selected elephants at the Pinnawala Elephant Orphanage in a linked series of pen trials focusing on product design, efficacy and the welfare of elephants. This project is conducted by Prof Saman Seneweera, Mr. Malitha Senanayake and Ms. Surendranie Cabral de Mel, in collaboration with Dr. Benjamin Allen, University of Southern Queensland, Prof Devaka Weerakoon, University of Colombo and Prof Ashoka Dangolla, University of Peradeniya. During the first year of the project, preliminary data on behavior and fecal samples were collected from which cortisol hormone (the hormone used as an indicator of physiological stress) was extracted. The prototype collar that can emit a range of warning signals was also designed and will be tested on the elephants. Welfare outcomes in response to warning signals will be determined by studying the behaviour and physiology of the elephants at different stages of the experiments with AGDs. We have developed a GPS tracking elephant collar to mitigate human elephant conflict.

### 7.3 Progress of the Science Education & Dissemination Unit (SEDU)-2019

#### **Objectives:**

Foster the exchange of technical and scientific information among the scientific community & promote the public understanding of science.

#### Forums for the scientific community:

- Special lectures: intended to provide a quick forum for the NIFS scientists and Research Assistants with the eminent scientists visiting the institute and the country
- Journal club meetings: organized for the IFS Research Assistants, for them to get an opportunity to discuss their research problems with the scientists and their peers
- International/National Workshops, symposia and conference

#### Promotion of public understanding of science:

To build up a scientific culture and to enhance the science tempo of the school community workshops, science camps and training sessions were conducted. In addition, the SEDU conducts programmes for the popularization of science through electronic media as well as printed media. SEDU is engaged in popularization of science and disseminating research findings of NIFS in different ways of communication. It holds and daily updates social media networks of NIFS and SEDU such as Facebook, Twitter, and LinkedIn which easily enable science communication and dialogue and official websites.

#### **Summary of Progress of the Division, based on the Key Performance Indicators (KPIs)**

##### **A. Events Held:**

| Category                     | Number of events held | Target Group                  | Number benefited |
|------------------------------|-----------------------|-------------------------------|------------------|
| Exhibitions (Local)          | 03                    | General Public                | 185,485          |
| Laboratory visits            | 08                    | Scientific & School Community | 220              |
| Special Lectures/Discussions | 13                    | Scientific community          | 424              |
| Symposia                     | 2                     | Scientific community          | 100              |
| Workshop                     | 03                    | School Community              | 170              |

## B. E-programs:

| Programme   | Performance in the year 2019  |                  |
|---|-------------------------------|------------------|
|   | (Performance Indicators)      | Number benefited |
| NIFS e-outreach<br>(Status: Ongoing)                                      |                               |                  |
| Facebook page   | Post Reached                  | 214,446          |
| Google My Business  | Views on Google Maps & Search | 179,297          |
| LinkedIn  | Post Reached                  | 190              |
| Twitter   | Post Reached                  | 5,994            |
| Web site  | Page Views                    | 22,000           |
| YouTube   | Views for videos              | 10,166           |
| Science Message Service<br>(Status: Ongoing)                              |                               |                  |
| Blog  | Page Views                    | 6,701            |
| Emails  | Emails sent                   | 6,720            |
| Facebook Page   | Post Reached                  | 99,016           |
| Twitter (Sinhala and English)   | Post Reached                  | 89,159           |
| Website (Sinhala & English)   | Page Views                    | 29,559           |
| Science YouTube Channel<br>(Status: Uploading currently on hold)          | Views for videos              | 188,847          |
| Mobile Apps for Science Students<br>(Status: Uploading currently on hold) |                               |                  |
| Periodic Elements game App  | Downloads                     | 34               |
| Sinhala Science Glossary App  | Downloads                     | 6,510            |
| Sinhala Science Website<br>(Status: Currently On hold)                    | Page Views                    | 6,000            |
| <b>Total benefited</b>  |                               | <b>864,639</b>   |

## 7.4 Progress of the Library - 2019

The Library of the National Institute of Fundamental studies continued to provide information and reference service to NIFS research staff and permitted scientific community on their inquiry.

### The library was engaged in the following services during the year

Provided reference and lending services, document delivery, resource sharing, inter-library loan facility, information alert services, new item arrivals alert service, sourcing web-based electronic journals and articles, Scientific Literature Updating Service (SLUS), provision of the updated and necessary information to the NIFS' administration such as government circulars, E-code, etc., access to the internet using updated computers and facilitating library users with photocopying and scanning facilities.

### Scientific Literature Updating Service (SLUS)

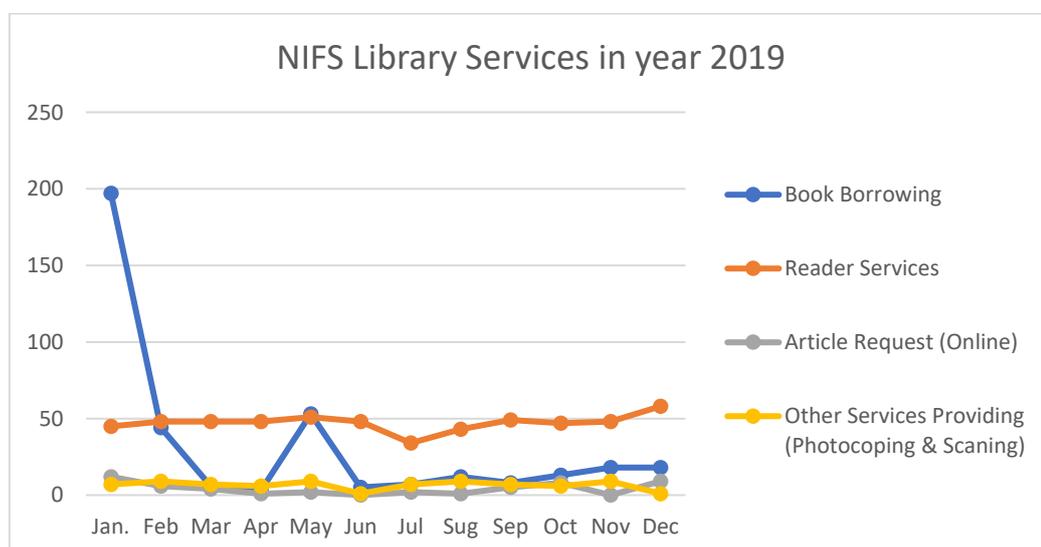
Scientific Literature Updating Service was set in motion according to the suggestion of the library committee, and the service is provided to the scientists of NIFS. When a scientist needs scientific literature updating on a selected topic, the keywords can be forwarded to the Library. Monthly or weekly updating can be done depending on the request. The NIFS library started this service before Elsevier and Springer Nature started similar services.

### The project of the compilation of research literature of pioneering scientists related to the NIFS was started by NIFS Library

This is a project set in motion to honor and pay tribute to our former Scientists. In the first phase, it was decided to collect the literature of the following scientists. Prof. A. Kovoov, Prof. C. Ponnampereuma, Prof. C. Wickramasinghe, Prof. C.B. Dissanayake, Prof. K. Tennakone, Prof. S.A. Kulasooriya. We hope to broaden our reach in the next phase. Accordingly, the library received 17 books written by Prof. C. Wickramasinghe. And also, it received an online access facility to the research article collections of Prof. C. Wickramasinghe through the center for Astrobiology in Sri Lanka.

### India Corner in the Library

On 9th July 2019, Assistant High Commissioner (AHC) Dharendra Singh inaugurated India Corner "Bharat EkParichay (Know India): Sharing knowledge with the world" at NIFS. AHC presented various books on Indian art, culture, and values to Prof. Saman Seneweera, Director, NIFS, for the established India corner.



## **7.5 Infrastructure development**

Followings are the major infrastructure developments that were completed during 2019;

- Construction of a new green house at the basement of the old building
- Construction of Barbed wire fence at Dambulla arboretum
- Installation of 150 KW Solar Energy system
- Renovation of Science Education & Dissemination Unit
- Renovation of the main auditorium stage
- Setting up of the National Battery Lab

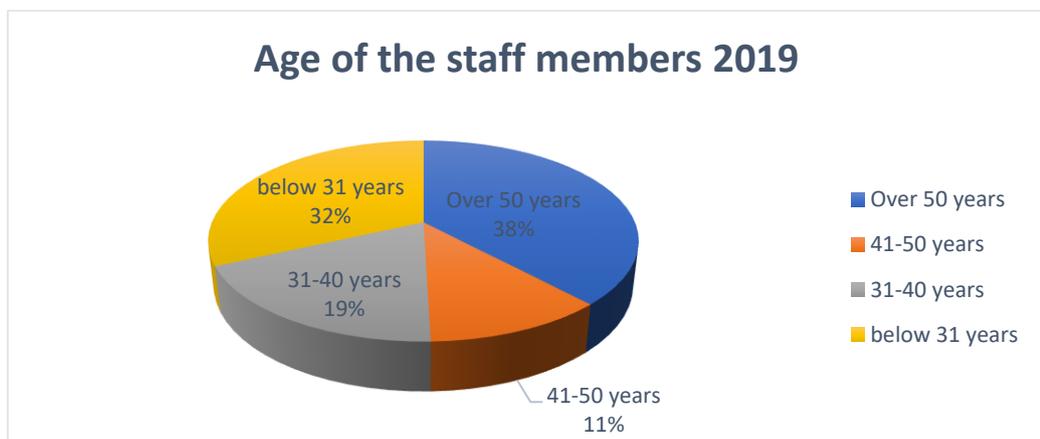
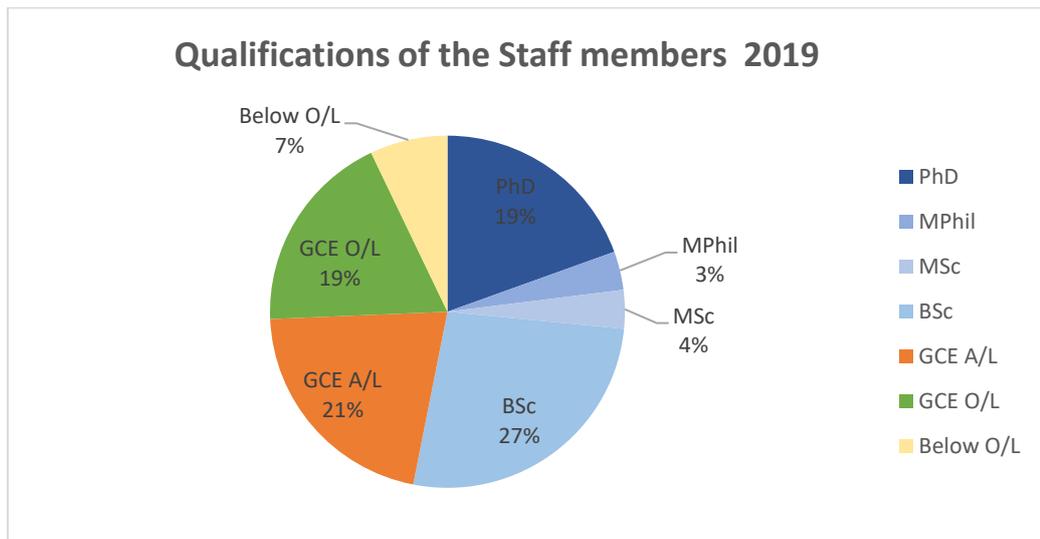
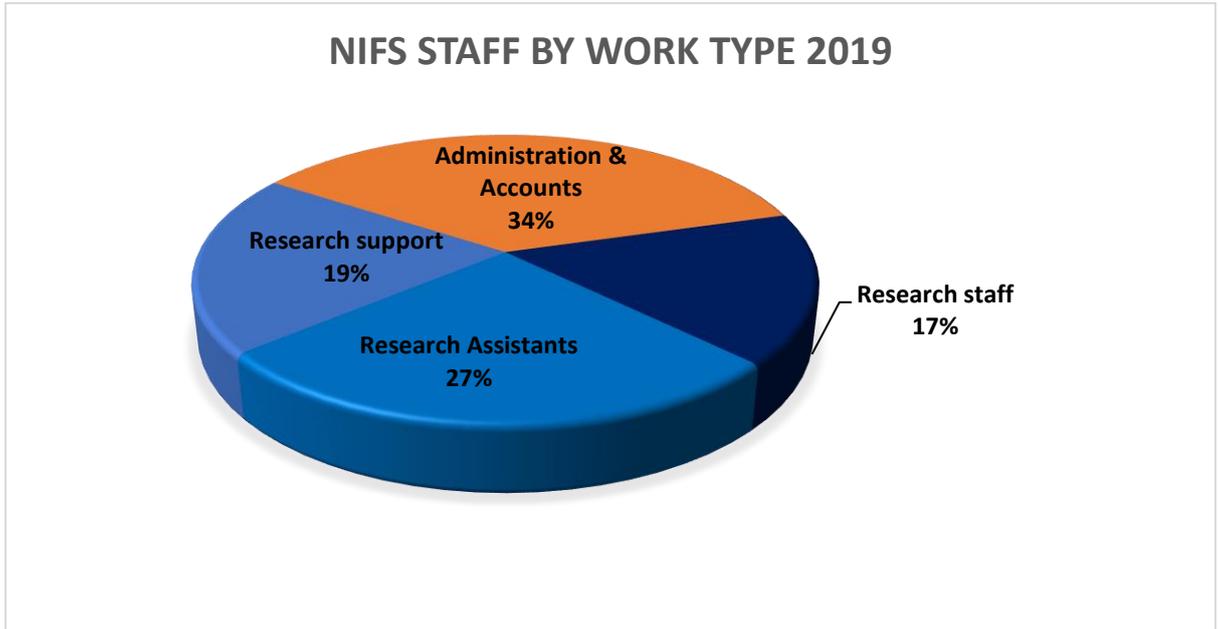
## **7.6 Major instruments purchased**

Following major instruments were purchased during 2019

- FTIR spectrophotometer
- Fume hood acid resistance
- Modular Multichannel Electrochemical Impedance Spectroscopy/Potent stat Galvano

## 8. NIFS Staff strength

### 8.1 Summary of NIFS Staff



## 8.2 NIFS Staff 2019 by service Level\*

| Service Level*      | Category                            |   | Number of employees    |
|---------------------|-------------------------------------|---|------------------------|
| <b>Senior Level</b> | Research staff                      | Director                                  | 01 (contract basis)    |
|                     |                                     | Senior Research Professors                | 04                     |
|                     |                                     | Research Professors                       | 04 (contract basis)    |
|                     |                                     | Associate Research Professors             | 05 (contract basis-01) |
|                     |                                     | Senior Research Fellows                   | 03                     |
|                     | Senior Managers                     | Research Fellows                          | 02 (contract basis-01) |
|                     |                                     | Secretary                                 | 01                     |
|                     |                                     | Coordinator/SDU                           | 01                     |
|                     | Middle Managers                     | Accountant                                | 01                     |
|                     |                                     | Chief Technical Officers                  | 13                     |
|                     |                                     | Laboratory Manager                        | 01                     |
|                     |                                     | Scientific Officer                        | 01                     |
|                     |                                     | Senior Assistant Librarian                | 01                     |
|                     |                                     | Senior Personal Secretary to the Director | 01                     |
| Tertiary level      | Accounts Officer                    | 01  |                        |
|                     | Administrative Officer              | 01  |                        |
|                     | Communication & Media officer       | 01  |                        |
|                     | Internal Audit Officer              | 01  |                        |
| Secondary Level     | Senior Staff Assistants             | 09  |                        |
|                     | Technical Officer Grade III         | 03  |                        |
|                     | Library Assistant Gr. III           | 01  |                        |
|                     | Management Assistant Gr. III        | 10  |                        |
| Primary level       | Driver- Special Grade               | 02  |                        |
|                     | Machinist – Special Grade           | 01  |                        |
|                     | Mason - Special Grade               | 01  |                        |
|                     | Laboratory Attendant- Special Grade | 02  |                        |
|                     | Record Keeper - Special Grade       | 01  |                        |
|                     | Audio Visual Assistant              | 01  |                        |
|                     | Karyala Karya Sahayaka- Driver      | 01  |                        |
|                     | Office Machine Operator             | 01  |                        |
|                     | Driver Gr. III                      | 05  |                        |
|                     | Lapidarist Gr. III                  | 01  |                        |
|                     | Machinist Gr. III                   | 01  |                        |
|                     | Electrician Gr. III                 | 01  |                        |
|                     | Office Aid                          | 02  |                        |
|                     | Primary Level -unskilled            | 03  |                        |

In addition, forty-one Research assistant positions are on contract basis.

\*based on 2/2016 circular sub schedule III

### **8.3 Staff Recruitments & end of service**

#### **8.3.A. Staff recruitment 2019**

Research Assistants (Gr.II)

Ms. D.M.D.M.Dissanayake  
Ms. Rasika Gunarathne  
Ms. N.D.U.S.Nakandala  
Ms. Maheshika Perera  
Mr. U.M.B.Premarathne  
Mr. R.A.Rathnayake  
Mr. I.B.Samarakoon  
Ms. A. Sathkunanadan  
Ms. S.M.V.K.Sewwandi  
Ms. K.M.De Silva Subaseela  
Ms. M. Tharmarajan  
Ms. S.M.N.K.Thilakarathne  
Ms. D.P.Ubeysekara

Scientific Officer

Dr. Shalini Rajakaruna

Primary Level-Unskilled

Mr. D.W.G.A.C.Dodamwala  
Mr. S.M.Malith Hasun  
Mr. P.G.N.S.Wijewardane

#### **8.3.B. End of service 2019**

Research Fellow

Dr. Gayan Bowatte (resigned)

Research Assistants

Mr. A.M.K.L. Abeykoon (resigned)  
Ms. E.M.U.A.Ekanayake (end of contract)  
Ms. H.K.S.N.S.Gunaratne (end of contract)  
Mr. G.D.K.Heshan (end of contract)  
Mr. J.A.D.M.N.Jayakody (end of contract)  
Ms. S.D.Jayasekara (resigned)  
Ms. S.K.Jayasekara (end of contract)  
Mr. B.A.Y.B.Jayawardena  
Ms. M.G.N.Perera (resigned)  
Mr. N.B.Suriyaarachchi (resigned)  
Ms. M.A.Y.N.Weerasinghe (resigned)

Chief Technical Officer

Ms. D.M.K.Lakshmi Kumari (retired)

Driver (special Grade)

Mr. K.M.Ariyawansa (retired)  
Mr. R.S.K.Gunawardena (retired)

Office Machine Operator

Mr. M.A.P.Perera (retired)

#### 8.4 Capacity Building / Skill Development Programs

| Name                         | Name of the Training Program  | Institute / Training Provider  | Funding Agency/ Institute   | Time period   |
|------------------------------|---|--|---|---------------|
| Mr. Viraj Ekanayake          | Distance Learning Course on "Cyber Security"  | Bangladesh Research and Education Network (BdREN)  | Facilitating Distance Learning using Digital Conference facility project from Asi@Connect | One Month     |
| Mr. S. Senthuran             | International Workshop on Introductory Training Course in Nano fabrication Technologies           | Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science, Bangalore, INDIA | Government of India   | Eighteen days |
| H.D. Jayasinghe              | Molecular training on plant systematics   | Singapore Botanic Garden   | National Herbarium, Department of National Botanic Gardens, Peradeniya                    | Eighteen days |
| Ms. S.K. Jayasekara          | International Training Programme on Biogas Production, Power generation and Vehicular Application | Delhi  | Institute of Technology, Delhi  | Twelve Days   |
| Miss. T.K. Bowange           | International Training Programme on Biogas Production, Power generation and Vehicular Application | Delhi  | Indian Technical & economic Cooperation   | Twelve Days   |
| Ms. J.M.P.S. Madamarandawala | International Workshop on TDR operational research workshop                                       | Colombo  | International union against tuberculosis and lung diseases                                | Twelve days   |

| <b>Name</b>                     | <b>Name of the Training Program</b>   | <b>Institute / Training Provider</b>                             | <b>Funding Agency/ Institute</b>                                 | <b>Time period</b> |
|---------------------------------|---|--|--|--------------------|
| Ms. J.M.P.S.<br>Madamarandawala | International Workshop on Asia<br>SORT IT operational research<br>course-Module 2   | Colombo  | International union against<br>tuberculosis and lung<br>diseases | Nine days          |
| Ms. D.P. Bopearachchi           | International Conference<br>on Student Conference on<br>Conservation Science (SCCS)   | Institute of Science (IISc),<br>Bengaluru- India                 | Institute of Science (IISc),<br>Bengaluru                        | Six days           |
| Ms. W.B.C.P.<br>Weerathne       | International Workshop<br>on Internship in minerological<br>study of asbestos-bearing<br>materials by optic microscopy and<br>X-ray powder diffraction analysis | Moscow, Russia   | Ministry of Science,<br>Technology and Research                  | Six days           |
| Miss. S.K. Jayasekara           | National Workshop<br>on Identification of non-lichenized<br>fungi and Mushrooms   | Royal Botanical Garden,<br>Peradeniya                            | Fee exempted   | Three days         |
| Mr. L. C. U. S. B<br>Lekamge    | Bamboo Processing in Sri Lanka  | United Nations Industrial<br>Development<br>Organization (UNIDO) | Global Environment<br>Facility (GEF)                             | One day            |

## 9. AUDITED FINANCIAL STATEMENT 2019

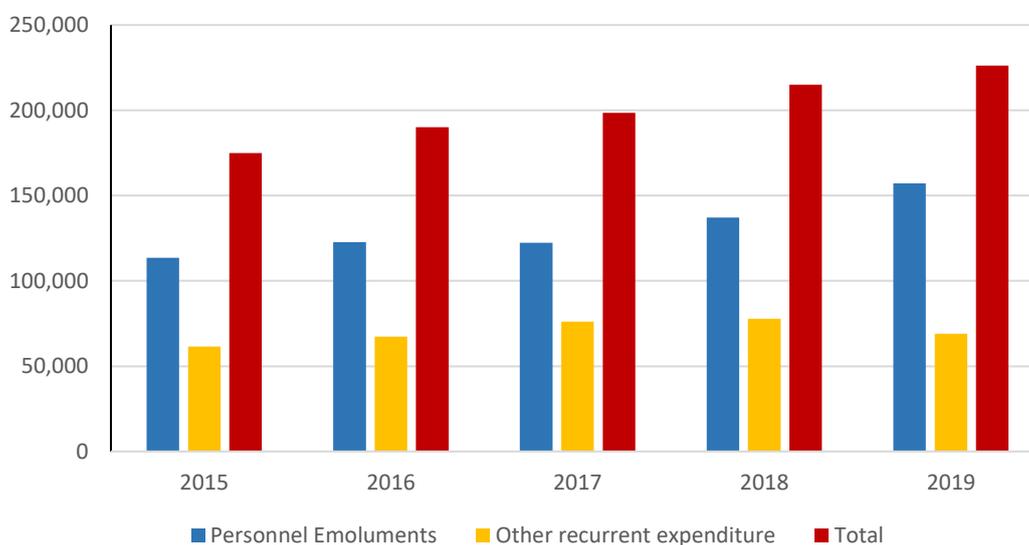
### 9.1 Summary of Financial Results

#### 9.1.1 Comparison of Expenditure with previous years

##### 9.1.1.1 Recurrent Expenditure comparison- five years

Rs.'000

|                             | 2015           | 2016           | 2017           | 2018           | 2019           |
|-----------------------------|----------------|----------------|----------------|----------------|----------------|
| Personnel Emoluments        | 113,491        | 122,808        | 122,430        | 137,142        | 157,177        |
| Other recurrent expenditure | 61,473         | 67,293         | 76,188         | 77,815         | 69,062         |
| <b>Total</b>                | <b>174,964</b> | <b>190,101</b> | <b>198,618</b> | <b>214,957</b> | <b>226,239</b> |



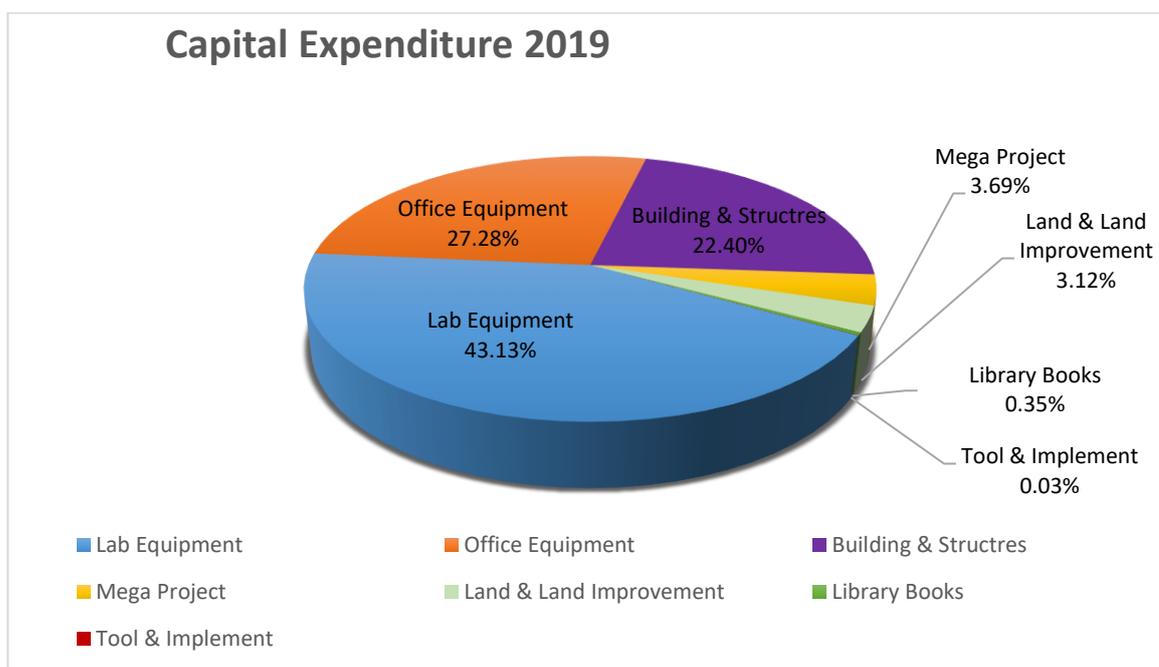
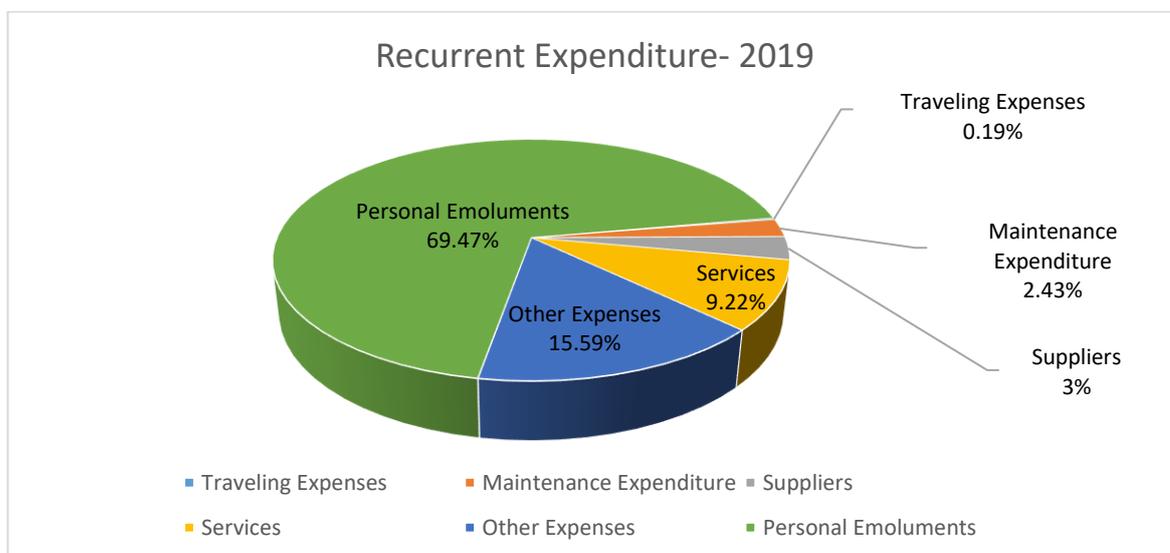
##### 9.1.2. Capital Expenditure comparison- five years

Rs.'000

| Year                        | 2015          | 2016           | 2017           | 2018          | 2019          |
|-----------------------------|---------------|----------------|----------------|---------------|---------------|
| Acquisition of fixed assets | 741           | 4,782          | 5,874          | 19,118        | 15,813        |
| Building Construction       | 43,852        | 125,261        | 110,674        | 58,374        | 66,025        |
| Research & Development      | -             | -              | -              | 15,458        | 3,135         |
| <b>Total</b>                | <b>44,593</b> | <b>130,043</b> | <b>116,548</b> | <b>92,950</b> | <b>84,973</b> |

## 9.2 Summary of financial results for the year ending 31.12.2019

|          | Recurrent         |       | Capital           |       |
|----------|-------------------|-------|-------------------|-------|
|          | Amount (Rs. '000) | %     | Amount (Rs. '000) | %     |
| 2018     |                   |       |                   |       |
| Budgeted | 276,189           | 100   | 267,516           | 100   |
| Approved | 190,000           | 68.79 | 120,000           | 44.86 |
| Released | 185,023           | 66.99 | 98,194            | 36.71 |
| 2019     |                   |       |                   |       |
| Budgeted | 338,993           | 100   | 546,250           | 100   |
| Approved | 201,171           | 59.3  | 81,000            | 14.83 |
| Released | 201,171           | 59.3  | 48,300            | 8.84  |

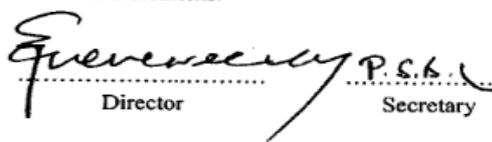


### 9.3 Statement of financial position

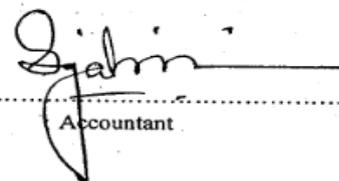
#### NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES SRI LANKA STATEMENT OF FINANCIAL POSITION AS AT 31.12.2019

|  |      | (RESTATED)            |                    |
|--|------|-----------------------|--------------------|
|  | NOTE | SLRs<br>2019          | SLRs<br>2018       |
| <b>ASSETS</b>                          |      |                       |                    |
| <b>CURRENT ASSETS</b>                  |      |                       |                    |
| CASH AND BANK BALANCES                 | 1    | 108,990,251.49        | 150,529,456        |
| DEPOSITS PREPAYMENTS & ADVANCES        | 2    | 26,948,257.89         | 14,022,035         |
| DISPOSAL OF FIXED ASSETS               |      | 59,669.77             | 59,670             |
| FESTIVAL ADVANCE FUND INVESTMENT       |      | 300,000.00            | 300,000            |
| CONSUMPTION LOAN FUND INVESTMENT       |      | 303,481.01            | 296,325            |
| INTEREST RECEIVABLE FOR FIXED DEPOSITS |      | 7,814,723.76          | 7,244,022          |
| STAFF CONSUMPTION LOAN                 | 3    | 5,015,609.06          | 4,805,947          |
| ADVANCE AND OTHER RECEIVABLE           | 4    | 161,317.94            | 241,747            |
| STOCKS                                 | 5    | 1,800,759.50          | 2,298,338          |
|  |      | <b>151,394,070.42</b> | <b>179,797,540</b> |
| <b>NON-CURRENT ASSETS</b>              |      |                       |                    |
| WORK IN PROGRESS                       | 6    | 6,227,761.41          | 17,455,040         |
| PRELIMINARY EXPENSES FOR CONSTRUCTION  |      | 332,319.49            | 711,307            |
| PROVIDENT FUND INVESTMENT              | 7    | 122,736,536.35        | 111,505,089        |
| TRAINING CAPACITY                      |      | 949,197.40            | 949,197            |
| MEGA PROJECT- RECHARGEABLE BATTERIES   |      | 2,116,425.75          | 939,080            |
| PROPERTY, PLANT AND EQUIPMENT          | 8    | 593,722,817.84        | 593,312,493        |
|  |      | <b>726,085,058.24</b> | <b>724,872,206</b> |
| <b>TOTAL ASSETS</b>                    |      | <b>877,479,128.66</b> | <b>904,669,746</b> |
| <b>LIABILITIES</b>                     |      |                       |                    |
| <b>CURRENT LIABILITIES</b>             |      |                       |                    |
| ACCOUNTS PAYABLE                       | 9    | 8,014,385.22          | 8,981,445          |
| ACCRUED EXPENSES                       | 10   | 3,131,903.55          | 3,351,446          |
|  |      | <b>11,146,288.77</b>  | <b>12,332,891</b>  |
| <b>NON CURRENT LIABILITIES</b>         |      |                       |                    |
| SPECIFIED FUNDS & GRANTS               | 11   | 156,978,269.37        | 150,873,195        |
| DEFERRED LIABILITIES                   | 12   | 188,461,590.38        | 109,852,958        |
|  |      | <b>345,439,859.75</b> | <b>260,726,153</b> |
| <b>TOTAL LIABILITIES</b>               |      | <b>356,586,148.52</b> | <b>273,059,044</b> |
| <b>NET ASSETS</b>                      |      | <b>520,892,980.14</b> | <b>631,610,702</b> |
| <b>NET ASSETS/EQUITY</b>               |      |                       |                    |
| CAPITAL FUND - SPENT                   | 13   | 670,608,789.86        | 668,452,882        |
| - UNSPENT                              |      | 63,862,681.00         | 99,020,834         |
| PRESIDENT'S FUND - SPENT               |      | 7,078,501.15          | 7,078,501          |
| ASSET REVALUATION RESERVE              |      | 118,388,385.47        | 118,388,385        |
| INSTITUTE FUND                         |      | (3339,045,377.34)     | (261,329,900)      |
| <b>TOTAL NET ASSETS/EQUITY</b>         |      | <b>520,892,980.14</b> | <b>631,610,702</b> |

The Accounting policies on pages 1 to 3 and other notes on pages 11 to 32 form and integral part of these Financial Statements. The Board of Directors is responsible for the presentation and preparation of these Financial Statements.

  
Director

  
Secretary

  
Accountant

## 9.4. Statement of financial performance

### NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

#### SRI LANKA

##### STATEMENT OF FINANCIAL PERFORMANCE FOR THE YEAR ENDED 31.12.2019

|                                   |      |                        | (RESTATED)          |
|-----------------------------------|------|------------------------|---------------------|
|                                   | NOTE | SLRs<br>2018           | SLRs<br>2018        |
| <b>OPERATING REVENUE</b>          |      |                        |                     |
| RECURRENT GRANT                   |      | 201,171,000.00         | 185,023,000.00      |
| OTHER INCOME                      | 14   | 38,433,128.88          | 23,958,585          |
| <b>EXPENDITURE</b>                |      | <b>239,604,128.88</b>  | <b>208,981,585</b>  |
| PERSONAL EMOLUMENTS               | 15   | 157,176,641.27         | 137,185,994         |
| TRAVELLING                        | 16   | 437,162.50             | 1,290,869           |
| SUPPLIERS & CONSUMABLE            | 17   | 6,986,476.91           | 15,444,754          |
| MAINTENANCE                       | 18   | 5,496,986.05           | 7,736,718           |
| CONTRACTUAL SERVICES              | 19   | 20,865,505.24          | 22,072,459          |
| DEPRECIATION                      |      | 92,272,862.18          | 85,070,357          |
| OTHER EXPENSES                    | 20   | 35,276,043.06          | 31,25,231           |
| <b>TOTAL OPERATING EXPENSES</b>   |      | <b>318,511,677.21</b>  | <b>300,056,382</b>  |
| DEFICIT FROM OPERATING ACTIVITIES |      | (78,907,548.33)        | (91,074,797)        |
| <b>FINANCE COST</b>               |      |                        |                     |
| PROFIT/(LOSS) OF FIXED ASSETS     |      | (200,049.93)           | (8,483,398.08)      |
| <b>NET DEFICIT FOR THE YEAR</b>   |      | <b>(79,107,598.26)</b> | <b>(99,558,195)</b> |

## 9.5 Statement of cash flow

### NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES SRI LANKA

#### STATEMENT OF CASH FLOW FOR THE YEAR ENDED 31.12.2019

|  | REFERENCE         | SLRs.<br>2019 | (RESTATED)<br>SLRs.<br>2018 |
|--|-------------------|---------------|-----------------------------|
| <b>Cash-Flow from Operating Activities</b>               |                   |               |                             |
| Deficit for ordinary activities                          | Page 5            | (79,107,598)  | (99,558,195)                |
|  |                   |               | <b>(99,558,195)</b>         |
| <b><u>Non Cash Movements</u></b>                         |                   |               |                             |
| Depreciation   | Page 19 - Note 8  | 92,272,862    | 85,070,357                  |
| Amortization of the Deferred Liability                   | Page 27 - Note 14 | (16,279,756)  | (4,485,370)                 |
| Loss on Disposal of Capital Assets                       | Page 5            | 200,050       | 8,483,398                   |
| Provision for Gratuity                                   | Page 30 - Note 20 | 6,932,429     | 6,075,930                   |
| (Increase)/Decrease Staff Consumption Loan               | Page 4 - Note 3   | (209,662)     | (177,058)                   |
| (Increase)/Decrease Stocks                               | Page 4 - Note 5   | 497,579       | 45,278                      |
| (Increase)/Decrease Advance and other<br>Receivable      | Page 4 - Note 4   | 80,429        | (57,386)                    |
| (Increase)/Decrease Deposits, prepayment<br>and Advances | Page 11 - Note 2  | (12,926,223)  | 7,781,569                   |
| Increase/(Decrease) Accounts Payable                     | Page 4 - Note 9   | (967,060)     | 2,481,178                   |
| Increase/(Decrease) Accrued Expenses                     | Page 4 - Note 10  | (219,542)     | 133,486                     |
| Gratuity Paid  |                   | (3,136,442)   | (571,238)                   |
| Increase/(Decrease) Differed Liability                   |                   | 6,438,257     | 4,484,631                   |
|  |                   |               | 72,682,921                  |
| <b>Net Cash flow from Operating Activities</b>           |                   |               | <b>(6,424,677)</b>          |
|  |                   |               | <b>9,706,580</b>            |
| <b><u>Cash Flow from Investing Activities</u></b>        |                   |               |                             |
| (Increase)/Decrease Working in progress                  | Page 4 - Note 6   | 11,227,278    | (15,295,040)                |
| Purchase of Property Plant & Equipment                   | Page 19-Note 8    | (87,805,084)  | (75,981,068)                |
| (Increase)/Decrease Int.rec.for Fixed Deposits           | Page 4            | (570,702)     | (631,078)                   |
| Construction   | Page 4            | 378,988       | (108,620)                   |
| Investments made- Provident Fund                         | Page 4 - Note 7   | (11,231,447)  | (22,230,737)                |
| - Consumption Loan Fund                                  | Page 4            | (7,156)       | (28,178)                    |
| -Mega Project  | Page 4            | (1,177,346)   | (939,080)                   |
| <b>Net Cash Flow from Investing Activities</b>           |                   |               | <b>(89,185,469)</b>         |
|  |                   |               | <b>(115,213,801)</b>        |
| <b><u>Cash Flows from Financing Activities</u></b>       |                   |               |                             |
| Government Capital Contribution                          | Page 6            | 48,300,000    | 98,193,544                  |
| Specific Funds and Grants                                | Page 4 - Note 11  | 5,770,941     | 31,580,329                  |
| <b>Net Cash Flow from Financing Activities</b>           |                   |               | <b>54,070,941</b>           |
|  |                   |               | <b>129,773,873</b>          |
| Net increase/ (Decrease) in cash and cash equivalent     |                   |               | (41,539,204)                |
| <b>Cash and cash equivalent at beginning of period</b>   | Page 11 - Note 1  |               | <b>150,529,456</b>          |
|  |                   |               |                             |
| <b>Cash and cash equivalent at the end of the period</b> | Page 11 - Note 1  |               | <b>108,990,251</b>          |
|  |                   |               | <b>150,529,456</b>          |

## 9.6 Statement of changes in net assets/equity

### NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

#### SRI LANKA

#### STATEMENT OF CHANGES IN NET ASSETS/EQUITY FOR THE YEAR ENDED 31.12.2019

| ATTRIBUTABLE TO OWNERS OF THE CONTROLLING ENTITY                |                                   |                     |                        |                                  |                                   |
|---|-----------------------------------|---------------------|------------------------|----------------------------------|-----------------------------------|
|   | CONTRIBUTED<br>CAPITAL            | PRESIDENT<br>FUND   | REVALUATION<br>SURPLUS | INSTITUTE<br>FUND                | TOTAL NET<br>ASSETS/EQUITY        |
| <b>BALANCE AS AT 31<br/>DECEMBER 2018</b>                       | 842,627,084.00<br>(75,153,367.60) | 7,078,501.15        | 118,388,385.47         | (265,649,541.04)<br>(193,665.00) | 702,444,429.58<br>(75,342,032.60) |
| ADD: FUND<br>ADJUSTMENT IN LAST<br>YEAR                         | -                                 | -                   | -                      | 4,513,306.28                     | 4513.306.28                       |
| <b>BALANCE AS AT 31<br/>DECEMBER 2018<br/>(RESTATED)</b>        | 767,473,716.40                    | 7,078,501.15        | 118,388,385.47         | (261,329,899.76)                 | 631,610,703.26                    |
| REVALUATION<br>DEFICIT/SURPLUS                                  | -                                 | -                   | -                      | -                                | -                                 |
| FIXED ASSET<br>PURCHASE FROM<br>GRANT                           | -                                 | -                   | -                      | -                                | -                                 |
| ADDITION DURING<br>THE YEAR TO<br>INSTITUTE FUND                | -                                 | -                   | -                      | 1,198,455.68                     | 1,198,455.68                      |
| DEFICIT FROM<br>OPERATING<br>ACTIVITIES                         | -                                 | -                   | -                      | (79,107,598.26)                  | (79,107,598.26)                   |
| DESPOSAL OF FIXED<br>ASSETS                                     | -                                 | -                   | -                      | -                                | -                                 |
| CAPITAL FUNDS<br>RECEIVED FROM<br>GOVERNMENT &<br>OTHER SOURCES | 48,300,000.00                     | -                   | -                      | -                                | 48,300,000.00                     |
| TRANSFER TO<br>DEFERRED LIABILITY                               | (81,302,245.54)                   | -                   | -                      | 193,665.00                       | (81,108,580.54)                   |
| <b>BALANCE AS AT 31<br/>DECEMBER 2019</b>                       | <b>734,471,470.86</b>             | <b>7,078,501.15</b> | <b>118,388,385.47</b>  | <b>(339,045,377.34)</b>          | <b>520,892,980.14</b>             |

## 9.7 Accounting policies year 2019

### NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES - SRI LANKA SIGNIFICANT ACCOUNTING POLICIES YEAR ENDED 31ST DECEMBER 2019

#### (1) GENERAL ACCOUNTING POLICIES

- 1.1** The financial statements have been prepared on the basis of historical costs in accordance with the Sri Lanka Public Sector Accounting Standards for the accrual basis accounting and no adjustments have been made for inflatory factors affecting these accounts, instead of Motor Vehicle re-valuation according to the special Re-valuation committee.
- 1.2** Similarly Laboratory Equipment, Machinery Tools & Implements, Refrigerators, Air Conditioners, Communication Equipment, Office & Miscellaneous Equipment, Sports Items are re- valued by the Special Re-valuation Committee and there is no inflator factors affecting to the accounts.
- 1.3** The value of Revaluation of Fixed Asset in 2011 and the value of Motor Vehicle in 2015 and 2018 have been shown as Revaluation Reserve being adjusted by Institute Fund Account. The Revaluation of Motor Vehicles has been done by Examiner of Motor Vehicles of Department of Motor Traffic, Kandy with effective dates of 16.02.2015, 20.02.2015 and 27.08.2018 at current market value.
- 1.4** Previous year figures and phrases have been re-arranged wherever necessary to confirm to the current presentation.

#### 1.5 CONVERSION OF FOREIGN CURRENCIES

All foreign exchange transactions are converted of the rate of exchange prevailing at the time the transactions were affected. Non-resident foreign currency account balance has been translated at the rate of exchange prevailing at the date of Statement of Financial Position.

#### 1.6 TAXATION

Under the provision of sections 8(a) (xxxix) and 42 (ff) of the Inland Revenue Act No. 28 of 1979 (as amended) the Institute is exempted from income tax in Sri Lanka.

#### (2) ASSETS AND BASES OF THEIR VALUATION

##### 2.1 STOCKS:

Stocks have been valued at historical cost basis and all issues are valued at FIFO Basis.

##### 2.2 FIXED ASSETS:

- 2.2.1** The cost of fixed assets is the cost of purchase or construction together with any incidental expenses thereon. The fixed assets are recorded at cost and accumulated depreciation which is provided in the depreciation on the basis specified in 2.2.6
- 2.2.2** Acquired the Grid Tied Solar Net accounting System, recognized as Building and Structure
- 2.2.3** The cost of Library Books includes a Heritage Asset (Mapping Report) amounting to Rs. 1,097, 477.65 which is not depreciable.
- 2.2.4** The cost of Lab Equipment and Office & Miscellaneous Equipment includes Assets which are kept for display purpose and are represented at Written Down Value of Rs. 16,317,450.00 and Rs. 770,940.00 respectively.

**2.2.5** Fixed assets received as Donations, have been recognized as Deferred Liability from year 2018.

**2.2.6 DEPRECIATION OF FIXED ASSETS**

The provision for depreciation has been calculated on the cost of fixed assets in order to write-off such costs over the estimated useful lives as follows:

|                                      |        |
|--------------------------------------|--------|
| Motor vehicles                       | 20%    |
| Library books                        | 33.33% |
| Building                             | 10%    |
| Lab Equipment                        | 10%    |
| Sports goods                         | 33.33% |
| Computers                            | 25%    |
| Computer Software                    | 25%    |
| Furniture & fittings                 | 10%    |
| Communication                        | 10%    |
| Air - Conditioners                   | 10%    |
| Refrigerators                        | 10%    |
| Machinery Tools & Implements         | 10%    |
| <b>Office &amp; Miscellaneous</b>    |        |
| Room Linen                           | 33.33% |
| Crockery Cutlery & Canteen Equipment | 33.33% |
| *Safety Equipment                    | 10%    |
| Office Equipment                     | 20%    |
| Sundry Assets                        | 10%    |
| Expandable Assets                    | 10%    |

\* Safety Equipment - Rate of depreciation had been changed from 33.33% to 10% with effect from 1999.

The depreciation of Fixed Assets is provided from the date of purchase to the date of disposal.

**2.3 INVESTMENT**

Employer's and employees' contributions made towards the NIFS provident fund has been invested in fixed deposits at the National Savings Bank.

**2.4** Contribution made towards Consumption Loan Fund has been deposited in Savings Account at the National Savings Bank.

**(3) LIABILITIES AND PROVISIONS**

**3.1** All known liabilities and provisions as at the date of the Statement of Financial Position have been provided for in the accounts.

**3.2 RETIREMENT GRATUITY**

Provision is made in these Accounts for retirement gratuity payable under the payment of Gratuity

Act No.12 of 1983 in respect of employees with 5 or more years of continued service in the Institute.

This item is grouped under deferred liabilities in the Statement of Financial Position.

**3.3 NIFS. PROVIDENT FUND**

Members' fund as at 31st December 2019 are shown under Specified funds in the Statement of Financial Position.

#### **(4) REVENUE RECEIPTS**

##### **4.1 GOVERNMENT GRANT**

Government grant received during the year under review towards the recurrent expenditure has been charged to the Statement of Financial Performance for the year. Total revenue and capital funds of the Institute accumulated from the previous years have been shown as Institute funds in the Statement of Financial Position.

##### **4.2 FOREIGN AND OTHER GRANTS**

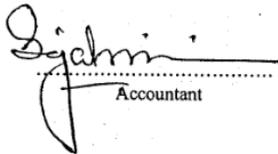
All foreign and other monetary grants received during the year, are dealt with by charging to the Statement of Financial Performance to the extent of such grants recognized in the Financial Statements do match with the associated costs incurred during the year. Unspent grants during the year are shown under specified funds and grants in the Statement of Financial Position.

##### **4.3 RESEARCH GRANT FUND**

The unutilized specified grant balances have been shown as the Research Grant Fund under Specified funds & grants in the Statement of Financial Position.

#### **(5) UTILIZATION OF BUDGET ALLOCATION**

The Revised Budget Estimate has been shown in the estimation and the previous year Capital Funds have been utilized in the reporting year.



Accountant

## **10. REPORT OF THE AUDITOR GENERAL ON THE FINANCIAL STATEMENT**

*(This is a translation. Please refer the report in Sinhala for the original)*

**Report of the Auditor General in terms of Section 12 of the National Audit Act, No. 19 of 2018 on the financial statements and legal and regulatory requirements of the National Institute of Fundamental Studies for the year ended on 31<sup>st</sup> December 2019.**

### **1. Financial Statements**

#### **1.1 Qualified Opinion**

The statements of financial position of the National Institute of Fundamental Studies as at 31<sup>st</sup> December 2019 and the financial statements comprising the statements of financial performance and cash flow statement for the year ended on 31<sup>st</sup> December 2019 were audited under my direction in pursuance of the provisions in the Article 154(1) of the Constitution of the Democratic Socialist Republic of Sri Lanka read in conjunction with the provisions of the National Audit Act, No. 19 of 2018. In terms of Section Article 154(6) of the Constitution of the Democratic Socialist Republic of Sri Lanka my report will be submitted to Parliament in due course.

It is my opinion, except for the effects of the matters described in the basis for the Qualified Opinion of my report, the financial statements as at 31<sup>st</sup> day of December 2019 comprising the statements of financial performance and cash flow statement reflect a real and fair view of the institute as per the Sri Lanka Public Sector Accounting Standards.

#### **1.2. Basis for the Qualified Opinion**

- (a) Though the primary task of the National Institute of Fundamental Studies is conducting researches on several disciplines, the accounting policy which needs to be followed while computing the respective expenses has not been divulged in the financial statements.
- (b) In terms of the paragraph 65 of Sri Lanka Public Sector Accounting Standard No. 07, since the effective duration of immovable properties have not been reviewed annually, though the immovable properties worth of Rs. 132,990,941/- have got depreciated they have been used continuously and there was no action undertaken to adjust the estimated fault in accordance to the Sri Lanka Public Sector Accounting Standard No.03.
- (c) Regarding the actual accounts balance of Rs. 118,388,385/- which was at the end of the audit year, in terms of the paragraph 90 of Sri Lanka Public Sector Accounting Standard No. 07 the required disclosing was not done in the statements.

- (d) In the case of misplaced assets worth of Rs. 5,693,070/- which were identified during the board of survey of inventory items in 2018, without taking action to remove them from the accounts, they have been shown under the assets, properties, expenses and equipment in the statement of financial position.
- (e) In order to confirm the title regarding the land worth of Rs. 28,622,151/- shown in the financial statements of the institute, the said information has not been submitted for the audit.

### **1.3. Responsibilities of the Management and Governing Authorities on Financial Statements**

The management is responsible for the preparation of financial statements that give a true and fair view in accordance with Sri Lanka Public Sector Accounting Standards and for such internal control to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

During the preparation of financial statements, the management is responsible for assessing the Institute's ability to continue as a going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Institute to cease operations, or has no realistic alternative but to do so.

As per Sub-section 16(1) of the National Audit Act, No. 19 of 2018, the Institute is required to maintain proper books and records of all its income, expenditure, assets and liabilities, to enable annual and periodic financial statements to be prepared.

### **1.4 Auditor's Responsibilities for the Audit of the Financial Statements**

My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Sri Lanka Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

In accordance with Sri Lanka Auditing Standards, I exercise professional judgment and maintain professional scepticism throughout the audit. I also:

- Identify and assess the risks of material misstatement, of the financial statements, whether due to fraud or error design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error as fraud may involve collusion, forgery, intentional, omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the District Secretariat's internal control.
- It had been included that structure and contained of the financial statements are based on transactions and events appropriate and fairly included when presenting the financial statements as a whole.
- Evaluate the overall presentation, structure and content of the financial statements including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

I communicate with the Accounting Officer regarding the other matters, significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

## **2. Report on Other Legal Regulatory Requirements**

The following facts are expressed according to the National Audit Act No.19 of 2018.

- According to the Section 12(a) of the National Audit Act No.19 of 2018, expect for the effects of matters described in the Basis for the Qualified Opinion of my report, relevant information and explanations have been obtained reasonably, which is my opinion were necessary for the purpose of the audit, and the Institute has maintained financial records.

- According to the Section 6(1) d(III) of the National Audit Act No.19 of 2018, it could be expressed that the financial statements presented are consistent with the preceding year.
- According to the Section 6(1) d(IV) of the National Audit Act No.19 of 2018, the recommendations made regarding the financial statements of previous years were included in the financial statements.

Based on the procedure carried out and evidences gathered, in all material respects, no observations were made which required the following statements.

- According to the Section 12(d) of the National Audit Act No.19 of 2018, any member of the governing body of the Institute has any direct or indirect interest of non-commercial nature in any contract entered into by the Institute.
- According to the Section 12(d) of the National Audit Act No.19 of 2018, the Institute has not complied with any applicable written law or other general or special directions issued by the governing body of the Institute, except for the following.

#### **Reference to Laws, Rules and Regulations**

#### **Non-Compliance**

##### (a) Financial Regulations of the Democratic Socialist Republic of Sri Lanka

##### (i) Financial Regulation 101 and Financial Regulation 104

Regarding 332 inventory items worth of Rs. 5,693,070/- found misplaced by the Board of Survey Committee of 2018, the action has not been taken in terms of the Financial Regulation and the action has been taken to write off the items worth of Rs. 344,915/- from the register upon the recommendation of the Board of Governor's.

##### (ii) Financial Regulation 770

Regarding 397 inventory items worth of Rs. 29,853,300/- recommended by the Board of Survey Committee of 2018 as those could not be utilized, the

action has not been taken in terms of the Financial Regulation.

(b) Section 14 of the Finance Act No. 38 of 1971 Finalized copy of the Annual Report of the year of audit 2018 was not prepared on the date of audit, 15<sup>th</sup> of May 2020.

(c) Treasury Circular No. 842 dated 19<sup>th</sup> December 1978 In the case of fixed assets worth of Rs. 1,028,584,797/-, those have not been maintained as permanent assets.

- In terms of the provisions cited in Section 12(g) of the National Audit Act No.19 of 2018, despite of the matters described in the qualified opinions of my report, as inconsistent with the powers, duties and activities of the institute the action has been under taken.

**Powers, functions and duties**

**Observations**

- (a) Letter of the Director of Management Services bearing No. DMS/608 dated 29<sup>th</sup> May 2014 For the post of Deputy Director (Research) though the approval has been obtained to recruit for the contract period of 3 years and though more than one year has passed, action has not been undertaken to fill up that vacancy.
- (b) Chapter XII of the Establishment Code of the Democratic Socialist Republic of Sri Lanka For the period from 19<sup>th</sup> August 2017 to 18<sup>th</sup> March 2018, a Professor who was serving in the post of Senior Professor in the University of Colombo was invited on leave approval. In favor of that an additional leave system was found introduced by the Administrative Committee of the institute since 7<sup>th</sup> October 2017 in the leave related chapter of the Establishments Code.

As per the requirement mentioned in Section 12(g) of the National Audit Act No. 19 of 2018, the resources of the institution have not been procured and utilized in accordance to the relevant rules and regulations in an efficient and effective manner except for the following observations.

- (a) In order to establish an integrated software for the institute a contract was signed with the private party on 28<sup>th</sup> of March 2016 for the sum of Rs. 2,200,000 and Rs. 660,000/- was paid as the advance money. In order to purchase computers and computer spare parts for that, the institute has spent Rs. 6,864,960/- during the period from 27<sup>th</sup> December to 02<sup>nd</sup> February 2019 and has not established the respective structure while reaching 31<sup>st</sup> December 2019.
- (b) The overall performance as per the rectified procurement plan for the audit year is only 46%.

### **3. Other Audit Observations**

- (a) Out of the 40 observations submitted by the Internal Audit during the year of audit and preceding year, action was not taken to adjust 32 observations.
- (c) As at 31<sup>st</sup> day of December 2019 for the 15 posts of the cadre of the institute 29 vacancies existed and out of them 10 vacancies existed in the Bidding Committee.
- (c) Since 1/3 (33%) of the approved cadre of the National Institute of Science for research activities remaining vacant, it is found as a big barrier to achieve the fundamental objectives of the institute.
- (d) In contradiction to the letter of the Director of Department of Management Services bearing No. DMC/25/02/7/277 dated 11<sup>th</sup> April 2011, 13 Technical Officers have been appointed for the post of Chief Technical Officer with effect from March 2013 by the Administrative Committee on 02<sup>nd</sup> January 2016.
- (e) Regarding the office equipment, library books and vehicles totally worth of Rs.727,748,547,724/-, the annual board of survey report was not submitted.
- (f) In order to obtain the legal possession of the land entitled to the Kantana Estate in extent of 14 Acres 02 Roods and 17.5 Perches which was transferred to the institute on 08<sup>th</sup> day of June 1990 by the Janatha Estate Development Board, action has not been taken.

(g) Out of the sum of Rs. 63,862,681/- which was allocated for the capital expenditure during the previous years, Rs. 51,287,288/- has been invested at a state bank without getting utilized for the said task.

W.P.C. Wickramatne

Auditor General

Issued on 23<sup>rd</sup> June 2020

## **11. OBSERVATIONS OF THE BOARD OF GOVERNORS FOR THE REPORT OF THE AUDITOR GENERAL**

*(This is a translation. Please refer the report in Sinhala for the original)*

**Observations of the Board of Governors on 11<sup>th</sup> September 2021 with regard to the Report of the Auditor General issued on 23<sup>rd</sup> June 2020 on the Financial Statements and other Affairs of the National Institute for Fundamental Studies for the year ended on 31.12.2019 in terms of Section 13(7)(a) of the Finance Act No. 38 of 1971.**

### **1.4.2 Non compliance with Sri Lanka Public Sector Accounting Standards**

#### **(a) Sri Lanka Public Sector Accounting Standard - 3**

Noted to disclose the relevant accounting policy followed by the NIFS in respect of their research activities in the Financial Statements in the future.

#### **(b) Sri Lanka Public Sector Accounting Standard - 07**

Although revaluation reports of many Non-Current Assets have been received, reports of several assets including land and buildings are to be received. As per the said revaluation reports, relevant adjustments will be made. Accordingly, values of Non Current assets that will continue to be used will be revised.

### **1.4.3 Accounting Policies**

**(a)** Noted to disclose the relevant accounting policy followed by the NIFS in respect of their research activities in the Financial Statements in the future.

**(b)** Noted to disclose the accounting policy followed in respect of revaluation reserves of the institution in the financial statements in the future.

### **1.4.4 Accounting deficiencies**

**(a)** Although the audit query states that 6 books out of 6890 books entered in the Board of Survey report have not been accounted for , it is hereby informed that the books purchased already have been taken into accounts. Action is being taken to make adjustments regarding 105 books which were misplaced before 2000 , subject to the approval of the Board of Governors. Steps have been taken to enter into the accounts only the price quoted books, out of 1631 books which were received as annual donations during the period from 01.09.1998 to 21.05.2021. As per the acquisition documents, it is proposed to revalue all the books in the library and the issue will be resolved thereby in the future.

**(b)** The values mentioned here have been resurveyed and records were kept to dispose the relevant assets.

- (c) Those are the remaining items of the last public auction held by the institution on 04.05.2018. The aforesaid six (06) lots of goods amounting to sum of Rs. 56,670/- contain tires, Fridges, exhausted fans etc. It was decided at the Audit and Management Committee meeting held on 09.06.2018 to sell these items at least at half of the value at a future auction. An auction could not be held again due to giving priority to revaluation activities of non-current assets of the institution and performing relevant field work. Noted to take appropriate arrangements and adjustments in the future.
- (d) Subject to the approval of the Board of Governors, action has been taken to write off 09 assets with no returns amounting to sum of Rs. 900,712.18/- not belonging to the institution which were entered to the accounts under noncurrent assets. These funds were given to the NIFS by the Eastern Provincial Agricultural Ministry to establish a Tissue Culture Laboratory, the said project was completed and all the equipments are in the possession of the relevant Ministry. This fund is not belonging to the NIFS. Water pumps contained in assets items amounting to sum of Rs.900,712.18/- are located in the Bogambara Bazaar and as they are now in used by the Municipal Council , notes were kept to deal with the relevant correspondence.

#### **1.4.5 Lack of evidence for audit**

- (a) Field inspection activities for revaluation of Fixed Assets of the institution have been completed as the first stage in maintaining the Fixed Assets register properly and as per the relevant forms General. Relevant revaluation report of several assets including lands and Buildings should be received. The Fixed assets register will be updated with new adjustments as soon as the balanced reports are received.
- (b) Survey reports were not submitted to audit as the survey was delayed due to Corvid pandemic. This was submitted on 29.10.2020.

#### **1.5 Non Compliance with laws, rules, regulations and Management decisions**

- (a) Maintenance of Sub inventory lists has been commenced with a view to find the lost items. Board of Survey has instructed to submit the details of the officers who held the last custody of the items which were clearly identified as lost items and action will be taken in accordance with the Financial Regulations after scrutinizing the relevant information.
- (b) As per the decision taken on 03.05.2016 lost items of the institution amounting to sum of Rs. 344,915/- were written off subject to the approval of the Board of governors (Annexure 2)(c) Items identified as unusable items by the Board of Survey are to be assessed by the Valuation Department and action will be taken to sell them in a public auction thereafter.

- (d) Presently, preparation of Annual reports for the year 2018 (Sinhala and English translation) has been completed and the Tamil translation is being prepared. This process was delayed due to Corvid pandemic.
- (e) Action will be taken to do the fuel combustion test according to the Public Administration Circular No. 30/2016
- (f) The relevant officers were instructed through an internal memo and action will be taken to make necessary rectifications.

## **2. Financial Review**

### **2.1 Financial Policies**

## **3. Operational Review**

### **3.1 Management deficiencies**

- (a) The relevant officers were informed to immediately update the personal files and the said activities are being implemented properly.
- (b) Noted to draw special attention on approving of leave chits and other activities related to leave.
- (c) Live run of the ERP system has been commenced from 01.05.2021. It is also advised to be informed of, if any problems arise to the users who are also taking hard copies in parallel with the live run.
- (d) NIFS does not have a Deed of Transfer or a plan to prove the ownership to this land and only a document has been granted by the National Housing Development Authority on 08.06.1990. As the said document is not sufficient to proceed with the matter related to the land, necessary documents and other activities are being fulfilled. Our lawyer was instructed to take further action on this issue at the Board meeting held on 20.03.2021.
- (e) Documents not yet provided are being received and the relevant documents will be collected as soon as possible to cover the liability of all the assets of the institution.

### **3.2 Controversial Transactions**

Action will be taken to deduct half day leave for additional short leave obtained.

### 3.3 Deficiencies in contract administration

The main reason for building the fence around the Arboretum estate, Dambulla was to prevent unauthorized entry and forcible seizures. As well, it has been reported during recent times that poachers had entered the Arboretum estate at night to hunt deer. Therefore, it was needed to build a fence as soon as possible to protect the said estate. If we waited for surveyor to survey the land and make the plan, it would take a long time.

Therefore, it was decided to construct the fence as soon as possible, considering the original live fence which was built at the time of acquisition of the estate, as its boundary. As per the audit observation speedy action will be taken to survey the land and to verify the boundaries.

### 3.4 Human Resource Management

I would like to bring to your attention the following vacancies and surplus identified during the audit with necessary explanations.

(a)

| Post                                 | Approved Cadre | Actual | Vacancies | Surplus | Explanations |
|--------------------------------------|----------------|--------|-----------|---------|--------------|
| Research Staff - Permanent           | 18             | 11     | 07        | --      | (i)          |
| Research Staff - Contract Basis      | 09             | 07     | 02        | --      |              |
| Deputy Director                      | 01             | --     | 01        | --      | (ii)         |
| Research Assistant - Contract Basis  | 41             | 32     | --        | --      | (iii)        |
| Communication & Media Officer        | 01             | --     | 01        | --      | (iv)         |
| Private Assistant to the Chairman    | 01             | --     | 01        | --      | (v)          |
| Driver                               | 08             | 05     | 03        | --      | (vi)         |
| Office Assistant                     | 03             | 02     | 01        | --      | (vii)        |
| Librarian                            | 01             | --     | --        | --      | (viii)       |
| Senior Assistant Librarian           | --             | 01     | --        | 01      |              |
| Chief Technical Officer              | 02             | 13     | 11        | 11      | (ix)         |
| Technical Officer                    | 14             | 03     |           | --      |              |
| Management Assistant - Non Technical | 17             | 18     | --        | 01      | (x)          |
| Library Assistant                    | 01             | --     | 01        | --      | (xi)         |

| Post                                      | Approved Cadre | Actual | Vacancies | Surplus | Explanations |
|---|----------------|--------|-----------|---------|--------------|
| Audio - Visual Assistant - Contract basis | --             | 01     | --        | 01      | (xii)        |

### Explanations

- (i) There are practical difficulties in filling these vacancies due to deficiencies in the required financial provisions and complications in providing physical facilities including laboratory equipment.
- (ii) The answer given to the audit query No 3 (b) is applicable to this issue.
- (iii) Advertisements have been published in the newspapers and institutional website to recruit Research Assistants on contract basis for 7 projects and interviews will be conducted for selected candidates as soon as there is a change in the instructions given by the government to suspend recruitments. Relevant web page and the paper advertisement is submitted herewith marked as annexure 2.
- (iv) Applications have been called through paper advertisements for the posts of communication and Media officers and written tests have been conducted and candidates have been already listed. Interviews will be conducted for selected candidates as soon as there is a change in the instructions given by the government to suspend recruitments.
- (v) Approval has been requested from the Department of Management Services to recruit an officer to the vacant post of Private Assistant to the Chairman. (Annexure 01)
- (vi) Applications have been called through paper advertisements for the post of Drivers and interviews also have been conducted for the selected candidates from the practical test and interviews will be conducted for selected candidates as soon as there is a change in the instructions given by the government to suspend the recruitments.
- (vii) Applications have been called through paper advertisement for the vacant post of Office Assistant.
- (viii) Explanation given under audit query No. 3(e) – Librarian and Senior Assistant Librarian, is applicable to this issue.
- (ix) The explanation submitted in respect of audit query No. 3(d) is applicable regarding 11 additional officers in the post of Chief Technical Officer and 11 vacancies in the post of Technical Officers.
- (x) Approval of the Department of Management Services has been obtained for the additional post of Management Assistant – Non technical.

- (xi) Recruitments have been made to the approved post of Library Assistant and the said officer serves in the said post w.e.f. 24.10.2014.
  - (xii) The explanation given in respect of audit query No 3(e) is applicable to the post of Audio-Visual Assistant (contract basis)
- (b) The post of Deputy Director (Research) should make a high contribution to the researchers conducted in the institution and should act to attract foreign research grants. Therefore, this post should be filled by a high level Research Scientist and should be given the same salary as a University Professor is entitled. A request has been made to the Department of Management Services to give approval to increase the approved salary scale entitled to this post up to UAC5 (2006) from UAC4 (2006). In response thereto, Department of Management Services has informed by their letter dated, 27.03.2017 that the UAC5 salary scale cannot be applicable to the said post. In addition, by their letter No. DMS/E2/62/7/277 dated 11.04.2011; instructions have been given to apply UAC4 salary scale to the said post. (Annexure 05). Therefore, action will be taken to discuss with the Department of Management Services regarding the discrepancy in the approved salary scale for the post of Deputy Director (Research).
- (c) Research Assistants are usually recruited on contract basis. They are leaving after the contract period and thereafter new appointees are recruited. Due to this circumstances, there is a temporary shortage of several officers. As per the government regulations, action is being taken to fill these gaps. Applications have already been called through paper advertisements for 7 projects. Interviews will be conducted as soon as there is a change in the instructions given by the government to suspend the recruitments. The answer submitted for observation 3(b) of the audit query is applicable to the vacancy in the post of Deputy Director of the Institution.
- (d) The institution had a special leave policy for their staff. The said policy was updated on 07.10.2017 by the Board of governors. The relevant leave policy of the staff is attached herewith. (Annexure 04). Prof. Asiri Nanayakkara requests paid leave from 19.08.2019 to 30.07.2020 (Until his 64<sup>th</sup> birthday) as per the part “e” of the leave policy of the NIFS to engage in research activities while working at the university .His leave application from 19/08/2019 up to 18/03/2020 (Until his 64<sup>th</sup> birthday) was approved at the meeting of Board of Governors held on 16/08/2019.This decision has been taken as per the method of approving leave in the university system. That is because the Lecturers and Professors of the NIFS are paid the same salary as in the university system. In addition, the Board of Governors decided that if he wants leave after 18.03.2019, he should inquire the said matter from the Ministry.

#### **4. Accounting activities and good governance**

##### **4.1 Cooperate Plan**

As per the relevant Public Enterprises Circular, action is being taken to prepare a compact plan for a period of 5 years and at present significant progress has been made in this regard. Assistance of the Ministry of Higher Education, Technology and Inventions is obtained for the purpose and this is updated before commencing each year and steps have been taken to obtain proper approval from the relevant parties.

##### **4.2 Action Plan**

Arrangements have been made to prepare the action plan from the year 2020, incorporating the key performance indicators for the relevant year so that the overall objectives of the organization can be achieved.

##### **4.3 Internal Audit**

Noted to expedite the rectifications related to observations.



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