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அடிப்படைக் கற்கைகளுக்கான தேசிய நிறுவகம்

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

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வருடாந்த அறிக்கை

ANNUAL REPORT 2020

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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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THE STATE MINISTRY OF SKILLS DEVELOPMENT,
VOCATIONAL EDUCATION, RESEARCH AND INNOVATION

National Institute of Fundamental Studies

ANNUAL REPORT

2020

Compiled by: Science Education & Dissemination unit (SEDU)

NIFS Cover Design: Mr. Gayan Bandara, Technical Officer/ NIFS

**** Please consider the English Medium document as the Main Report (section 1-9), since the working medium of the Institute is English Language**

Content of Annual Report 2020

1. INTRODUCTION

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"

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 dissemination of scientific knowledge;

- Invite scientists from Sri Lanka and abroad, actively engaged in research and creative work to deliver lectures and participate in NIFS activities;

- Establish and maintain liaison with scientists 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 studies leading to the award of postgraduate degrees by institutions recognized by the University Grants Commission of Sri Lanka 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 & Physics of Materials 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

- Microbiology & Soil Ecosystems research project
  Rhizobium research project
- Microbial Biotechnology research project

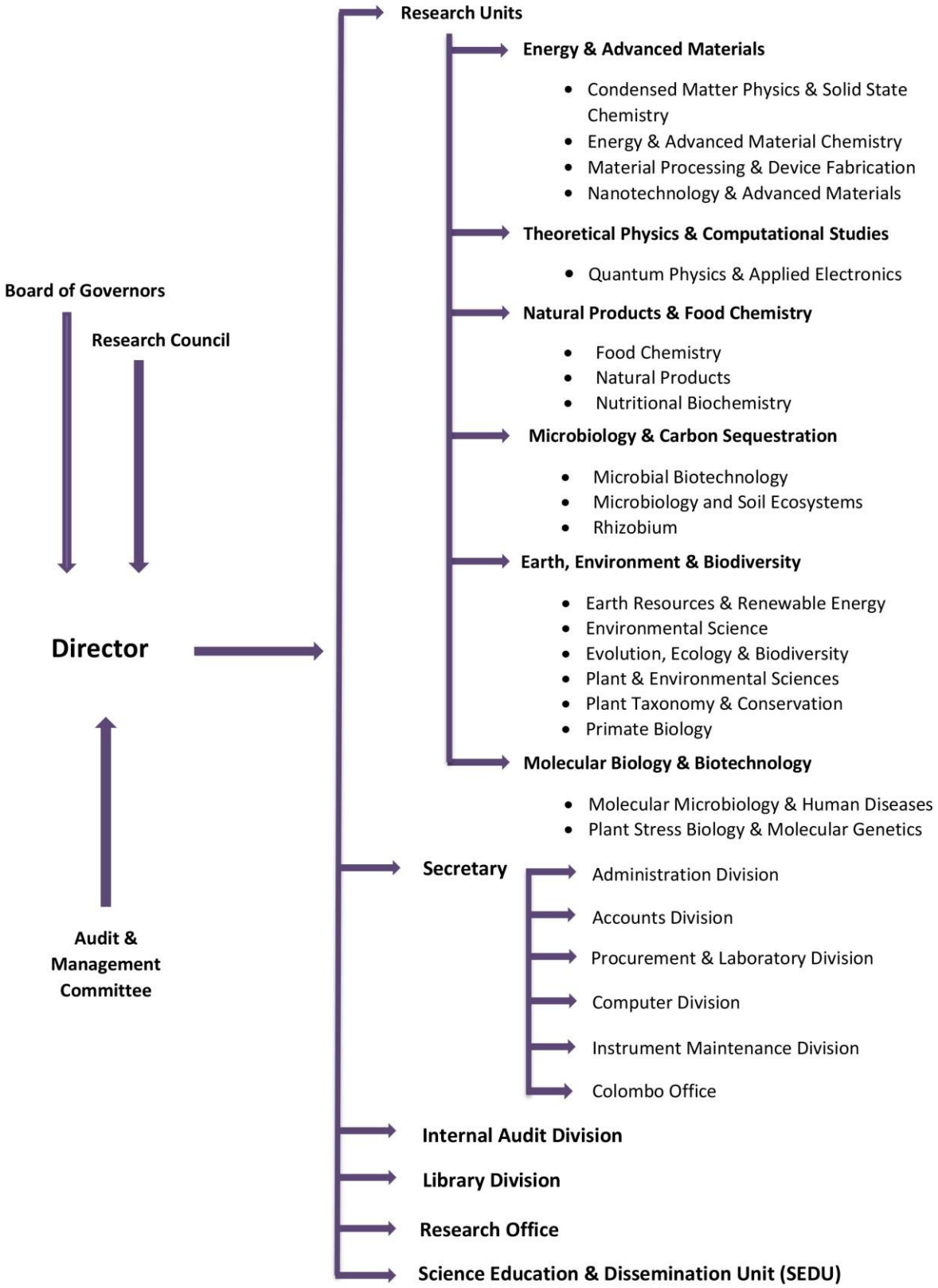
EARTH, ENVIRONMENT & BIODIVERSITY RESEARCH UNIT

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

MOLECULAR BIOLOGY & BIOTECHNOLOGY RESEARCH UNIT

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

2. NIFS ORGANIZATIONAL CHART



3. BOARD OF GOVERNORS 2020

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

Chairman -*Appointed by H.E the President*

- **Prof. A. Sumathipala,** Faculty of Health Keele University, United Kingdom

Members

Ex-Officio members

- **Professor N. Kottegoda.,** The Advisor to the President on Scientific Affairs
- **Prof. S. Amaratunge,** Chairman/ University Grants Commission
- **Prof. Saman Seneweera**, Director/ NIFS

Appointed by H.E the President

- **Professor M.A.K.L. Dissanayake,** Research Professor/NIFS
- **Dr. Nishantha Perera,** Department of Mathematics, University of Colombo

Appointed by the Minister

- **Mr. Anura Dissanayke**, Secretary to the Ministry of Irrigation
- **Eng. N. Rupasinghe**

Elected by the Research Council

- **Prof. M.C.M. Iqbal**, Associate Research Professor/ NIFS

Treasury Representative

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

Secretary to the Board of Governors/ NIFS

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

As at 31/12/2020

4. RESEARCH COUNCIL 2020

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

Chairman

- **Prof. Saman Seneweera**, Director/ NIFS

Members

Appointed by H.E the President

- **Prof. Jayasinghe R. D.**, Department of Oral Medicine and Periodontology Faculty of Dental Studies, University of Peradeniya
- **Prof. Yakandawala D.M.D**., Department of Botany, Faculty of Science, University of Peradeniya

Ex-Officio:

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

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

Elected by the Research Fellows of National Institute of Fundamental Studies

- **Dr. Jayaratne I.P.L.**

Nominated by the University Grant Commission

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

Secretary to the Research Council

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

As at 31/12/2020

5. AUDIT & MANAGEMENT COMMITTEE 2020

Chairman

Ms. Rathnayake J.M.S.D
(Treasury Representative)
Additional Director General, Department of National Planning, Ministry of Finance

Committee Members

- **Eng. Rupasinghe N.** (Board Member)
- **Prof. Dissanayake M.A.K.L.** (Board Member)

Secretary to the Committee (Convener)

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

Observers

- **Mr. Wickramasinghe S. W. D. N.**
  Audit Superintendent, National Audit Sub Office, University of Peradeniya
- **Mrs. Anuruddhika H. D.**
  Chief Internal Auditor, Ministry of Science, Technology and Research

By invitation

- **Prof. Seneweera S.** (Board Member)
  Director / CEO / CFO, National Institute of Fundamental Studies
- **Mrs. Samarakkody P. S. S.**
  Accountant, National Institute of Fundamental Studies

6.1. Chairman's Message

As the Chairman of the National Institute of Fundamental Studies, I am delighted to deliver this message to the Annual Administrative Report 2020.
The Annual Administrative Report provides an opportunity to identify our strengths and to strengthen them further and also to minimize our weaknesses or limitations as well as to follow up on what we have been doing in the previous year. Further, it is very important to share this follow-up with policy makers, planners and administrators as it would provide a good opportunity to revise our strategies, operations and directions. Strategy means grasping the opportunity which is a dynamic process and not a static one. This follow-up is even more important in light of the new and unexpected challenges we have to face.

Despite Sri Lanka's relative success in controlling the epidemic and introducing vaccines in an unprecedented global pandemic of COVID 19, these ongoing challenges will remain for quite some time. In addition to that fact, today we face issues directly related to COVID-19 as well as issues that are not directly related. We are facing two major issues i.e. energy and the issue related to agriculture. Our institution is engaged in research in these two fields. Therefore, we have a moral responsibility to see how our research can make culture shift in ways that benefit the public. We are accountable to people and society as we are products of free education and we utilize public money and public knowledge. As such, we will have to review not only our research, but also the context in which the research should be conducted.

It is manifest that there is a close correlation between today's post-industrial knowledge, economy, economic growth, innovations and indigenous research capacity. University-based research has been the most effective factor in such economically relevant innovations.
Research universities work on basic and applied research to create and disseminate knowledge, and institutions like ours are capable of developing mechanisms to effectively use this knowledge in collaboration with industry for generation of intellectual property and for knowledge/technology transfer for commercialization. Therefore, through technology transfer, research knowledge should be converted into products that benefit the people. We now have to make a significant effort in our journey to make a decisive contribution towards it.

I am sure we are able to do that in the near future especially in our work related to energy, power and agriculture.

Professor. Athula Sumathipala
Chairman/National Institute of Fundamental Studies

6.2. DIRECTOR'S REVIEW 2020

The National Institute of Fundamental Studies, Sri Lanka (NIFS, formerly Institute of Fundamental Studies Sri Lanka) was established by an Act of Parliament (Act No. 55 and amendments) in 1981. It was the brainchild of HE J. R. Jayawardhana, who firmly believed that national development programs should always harmonize with their respective fundamental research components to ensure the sustainability of the programs. The NIFS is modelled around the Max Planck Institute (Germany), Weizmann Institute of Science (Israel) and Tata Institute for Fundamental Research (India).

The NIFS is administered by a Board of Governors consisting of 11 members. chaired by Professor Athula Sumathipala. The Board provides strategic and administrative directions for the Institute. The Research Council consists of 23 members including eminent scientists selected from other national universities and Senior Research Professors, Research Professors, Associate Research Professors & Senior Research Fellows of National Institute of Fundamental Studies. It meets once a month to make recommendations to the Board on all matters pertaining to the planning and implementation of research projects.

The NIFS is mandated to conduct fundamental research and foster public understanding of science. Illustrious Sri Lankan scientists with excellent global recognition have directed the Institute from its inception under the chairmanship of the Head of the State, and presently with the Ministry of Science Technology. Prof. Chandra Wickramasinghe (UK), Prof. Cyril Ponnamperuma (USA), Prof. K. Tennakone (Sri Lanka), Prof. C.B. Dissanayake (Sri Lanka) and Prof. SHPP Karunarathne (Sri Lanka) served as past directors. The city of Kandy has a unique historical and research culture, blessed by the University of Peradeniya and twenty or so other research organizations and has become an ideal home for NIFS. The NIFS moved to Kandy (Hotel Hantane) in 1985 under the directorship of Prof. Cyril Ponnamperuma. Within two years, a modern laboratory complex equipped with state-of-the-art facilities was in place through a generous grant from the Government of Japan (US$ 5.5 million), to serve the nation.

Currently, the NIFS has 19 research projects, 18 scientists, 41 research students and 04 national centers. The NIFS' adjunct professorial positions attracted 18 outstanding scientists from around the world at no cost to the Institute. NIFS scientists have research collaborations with national (17) and international research institutes (22) and have secured competitive national and international grants to fund their research. NIFS scientists have claimed world recognition, especially in research. For example, a very recent achievement is by 2 NIFS scientists Prof Bandara and Prof Seneweera who were recognized in the top 2% of world scientists. During the past decades, over 1521 peer-reviewed research publications (SCI and SCIE), and 09 patents have resulted. The number of citations to the 1521 research publications is 22,861. During this period, NIFS has also trained 1530 postgrads and 1652 undergraduate students in a wide range of disciplines. Presently, we have over one hundred students in any given year going through our training process, through which we have substantially reduced foreign exchange moving out of the country and reducing brain drain.

Our science outreach program has reached 669,012 school children while 6000 of them were given the opportunity to come to NIFS and obtain first-hand experiences in science as a career. Globally, the benefits of fundamental research to society are not immediate. For example, over two decades of fundamental research in molecular microbial biotechnology, have led to scientific discoveries that have transformed into application science, production of biofilm

fertilizers as an alternative to chemical fertilizers direct annual saving over LKR 9 billion. Further, there are unquantifiable health and environmental benefits, as well. Our scientists have also successfully conducted research into high-end technology development, particularly in value addition to national mineral resources. For example, seven graphite- based materials and energy devices have been patented locally but have large global market potential.

Human resource development for the research staff is provided through in-house workshops, participation in national and international workshops and presentation of research findings at national and international fora. Besides participating in numerous workshops and training courses, the NIFS also initiated the first national conference for young scientists. Further, the Science Education Dissemination Unit conducted programs for school teachers and students through workshops, seminars, competitions, exhibitions and laboratory demonstrations. Scientists and research assistants were also the recipients of many international and national awards while institutional national ranking (webometrics) improved from 37 (2018) to 14 (2020). The findings from these research activities were published in international and national peer reviewed journals, in conference proceedings and abstracts, in technical and consultancy reports, and miscellaneous publications. Despite the COVID 19 pandemic, the Institute's research outcome was maintained, and thus the institute has made good progress even during this difficult time.

In consonance with the Vistas of Prosperity and Splendours and UN SDG goals, NIFS continues to offer professional expertise in fundamental science research to the Government of Sri Lanka in solving national problems. The instrument facility at NIFS with in house maintenance will be declared as a resource for the entire nation. A social science research program will also be commenced shortly. NIFS continues to promote dialogue amongst peers via research conferences and symposia. The Institute also fosters public understanding and social outreach of science via a dedicated digital channel. Even though the manually driven administration and finance operations were highly commended in the 2019 Auditor-General Report, the Institute has moved into automated administration and finance operations within a legal framework and a virtual research platform for constant dialogue. With the research faculty of the Institute being doubled in the near future and improved laboratory and residential facilities, the NIFS will emerge as a model institute not only nationally but also globally.

Professor Saman Seneweera
Director, NIFS and Senior Research Professor Chief Executive officer/Chief Finance officer

7. SUMMARY OF THE PERFORMANCES OF INSTITUTE IN THE YEAR 2020

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, 2020 the institute has published 78 articles out of which 42 articles are published in journal with Scientific Journal Ranking (SJR) index and included in Q journals [1];
    - Twenty-four research papers published in QI journals
    - Fifteen research papers published in Q2 journals
    - Three and one research papers published in Q3 and Q4 journals respectively
    - Remaining Thirty-five research publications in other refereed journals

- Besides, 70 research articles were published as conference proceedings and abstracts. Also, three books/Monographs & Book Chapters were published. Furthermore, 10 articles were published in magazines & newspapers to disseminate the scientific findings' details to the general public.

- Scientists were capable of attracting funds for their research projects; 04-new grants & 34 ongoing grants

- We have 51 research collaborations out of which 01 was initiated in the year 2020. Details of the Research collaborations with universities & institutions are as follows*;*

Australia

- La Trobe University
- Queensland University of Technology
- University of New England
- University of Western Sydney
- University of Southern Queensland

Bangladesh

- GonoBishwabidyalay (University), Savar, Dhaka

Canada

- Dalhousie University, Canada.
- University of Guelph, Canada.

China

- Chinese Academy of Sciences
- Hefei University of Technology

Germany

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

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

India

- Indian Institute of Science
- Shri Mata Vaishno Devi University

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

-
- Aquinas University College
- Coconut Research Institute, Lunuwila
- Department of Agriculture
- National Herbarium, Peradeniya
- Open University of Sri Lanka, Nawala
- Respiratory disease treatment unit, Teaching hospital, Kandy
- Sabaragamuwa University of Sri Lanka
- University of Jaffna
- University of Kelaniya,
- University of Peradeniya,
- University of Ruhuna
- Uva Wellassa University
- University of Wayamba

United Kingdom

- Buckingham Centre for Astrobiology, Buckingham
- University of Aberdeen, UK

United State of America

- California Polytechnic State University, San Luis Obispo
- Georgia State University, USA
- Smithsonian Conservation Biology Institute, Washington, DC

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

Degree	completed	in progress
PhD	2	20
MPhil	3	45
MSc	2	13
B Sc research project	14	22

7.2 Progress of Research Projects

7.2.1. Condensed Matter Physics & Solid-State Chemistry research project

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

Introduction to Research Project

The Condensed Matter Physics & Solid-State Chemistry project at NIFS during the year 2020 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 enhancing the efficiency of dye sensitized solar cells by (a) synthesizing and characterizing novel solid polymer electrolytes and quasi-solid state (gel) polymer electrolytes and (b) by designing and fabricating novel TiO_2 based photoanodes incorporating quantum dots, plasmonic effect, and by nano structural modifications to TiO_2 layer.

Activities carried out during the year 2020

During the year 2020, the following dye sensitized solar cell systems were fabricated and characterized and results were published in SCI and SCI (Expanded) international journals. Also, the training of ONE Ph.D. was completed and FIVE more PhD and MPhil research students continued their full-time training under this project.

- Polyaniline (PANI) mediated cation trapping effect on ionic conductivity enhancement in poly (ethylene oxide) based solid polymer electrolytes was studied for the first time with application in solid state dye sensitized solar cells.
- Efficiency enhancement in dye-sensitized solar cells using hierarchical TiO_2 submicron size sphere as a light scattering layer was studied and results were published.
- Effect of PbS quantum dot-doped polysulfide nanofiber gel polymer electrolyte on efficiency enhancement in CdS quantum dot-sensitized TiO_2 solar cells was studied and results were published.
- Highly efficient plasmonic dye-sensitized solar cells with silver nanowires and TiO_2 nanofibres incorporated multi-layered photoanode were successfully studied and results published.
- A novel, PbS: Hg quantum dot-sensitized, highly efficient solar cell structure with triple layered TiO2 photoanode was studied and results published.

In addition, the research group participated and contributed immensely to the success of the following national and institutional activities:

- **Cyril Ponnamperuma International Conferenc**e on Multidisciplinary Research, 21st January 2020.
- **NIFS Annual Review**-2019, held on 30th July 2020
- **INOTECH** National Exhibition held in Pitipana, Homagama (11-14 March 2020)
- **National Conference** on Multidisciplinary Research held at NIFS on 8th October 2020
- Development of a Hypochlorite disinfection system made at NIFS for Covid-19 (March 2020)
- Project Leader Coordinated as a Deputy Director of the National Solar Panel project of the Ministry towards locally manufacturing thin film solar panels and the training of Solar Technicians at NVQ 4/5 levels.

7.2.2. Earth Resources and Renewable Energy research project

Project Leader- Prof. N.D. Subasinghe

Introduction to Research Project

Despite its size, Sri Lanka has several economic minerals resources, as well as potential geothermal resources. Understanding the origin of minerals and rocks in Sri Lanka as well as the geothermal resources will not only help to identify new resources, but also will help to understand the origins of lithological complexes in Sri Lanka and contribute to the advanced knowledge.

Sustainable utilization of known deposits as well as finding hitherto unknown mineral deposits will contribute to the economic development of the country. Sub project on geothermal resources of Sri Lanka has both fundamental and applied aims. Geothermal energy can be used as a renewable energy source. 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. Evaluation of mineral resources, with a focus on the origin and economic potential of Sri Lankan rocks are also carried out as sub projects.

Research on thermoelectricity is relatively new to Sri Lanka. While thermoelectricity can generate electricity directly from heat, and can be used as a renewable source, one of the major advantages is its unique ability to increase the overall efficiency of an existing system by scavenging and converting waste heat to electricity through co-generation.

Activities carried out during the year 2020

Geological, geochemical and geophysical techniques were employed to investigate the nature of the geothermal resources. One of the non-invasive, passive geophysical techniques used in the survey was Magneto-Telluric (MT) technique. Time-Domain Electromagnetic (TDEM) is an active technique used in the survey. Without the need for drilling, the above two techniques can provide information on geological structures, heat sources and water resources hidden under the earth. Processing and interpretation of previously collected data were carried out.

A sub-project “Probing the provenance & distribution of heavy mineral placer deposits in coastal areas of Southern India and south-west Sri Lanka”, which is funded by the Ministry of Science & Technology, is conducted in collaboration with the Department of Geology, University of Sri Lanka.

Another subproject started recently is “Petrogenesis, geochemistry and potential of economic mineralization of granitic pegmatite in Sri Lanka”. This is funded by NRC. Field work, collection of samples and petrographical studies have been carried out.

NIFS started the pioneering project on Thermoelectricity (TE). This research project is focusing on developing low-cost TE material from locally available raw materials such as graphite and its derivatives. Graphene Thin Films produced at NIFS using Sri Lankan natural graphite show promising thermoelectric properties. These thin films may be used in niche applications such as extracting waste heat to power-up portable electronic devices and bionic devices.

Theoretical modelling to study the teat distribution in thin films and coated substrates has been carried out to understand and to improve the practical aspects of thermoelectric generations by enhancing the thermoelectric properties as well as the power output of TE modules.

7.2.3. Energy & Advanced Material Chemistry research project

Project Leader –Prof. 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 reactions 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_2 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. In the research topics of conversion of solar energy into electrical energy, our research is mainly focused on the understanding and improvement of fundamental requirements (efficient harvesting of sun light and efficient separation of excited charge carriers) of different types of solar cells such as dye-sensitized, polymer and q-dot sensitized solar cells. In this project, novel light harvesting materials are synthesized and their charge separation as well as charge recombination properties being investigated in order to fabricate solar cell devices. The main objective of this research is to fabricate a low-cost solar cell by enhancing the light absorption and charge carrier separation.

Activities carried out during the year 2020

Harvesting of waste energy is one of the most promising technologies to address the contemporary energy shortage. The basic concept in waste energy harvesting technology is the conversion of waste energy such as heat, vibrational energy and mechanical energy into usable forms of energy such as electrical energy or chemical energy. Recently, there is a keen interest in the use of piezoelectric materials in harvesting the waste energy and the use of the piezoelectric properties of piezoelectric materials is a very promising source of alternative energy harvesting method. Finding an appropriate piezoelectric material for piezocatalytic applications is an uphill task. Potassium niobate ($KNbO_3$) and sodium niobate ($NaNbO_3$) gained much interest in piezoelectric materials in harvesting waste energy especially in piezotronic devices. In this investigation, we synthesized the piezoelectric $KNbO_3$ by modified solid-state reaction and enhanced the free charge carrier in piezoelectric $KNbO_3$ by introducing a large number of oxygen vacancies and demonstrated the excellent piezocatalytic activity of $KNbO_3$ by harnessing waste energy to produce H_2.

Thin-film solar cells technology is one of the solutions for expensive silicon solar cells. The kesterite-structured Cu_2ZnSnS_4 (CZTS) semiconductor has been considered as a promising light-harvesting material and a great progress on CZTS based solar cells has been achieved during the past few years. For the fabrication of CZTS solar cells, vacuum and non-vacuum deposition techniques have been reported. Among these methods, non- vacuum techniques such as spray pyrolysis, spin coating, and electrodeposition are widely being used owing to their simplicity and the low cost.

7.2.4. Environmental Science Research Programme

A. NIFS Water Research Project

Project Leader – Prof. Rohan Weerasooriya

Introduction to Research Project

UN directives[2] declare that *"the human right to water entitles everyone to be sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use."* Sri Lanka is not a water-scarce nation! The distribution of water resources is uneven. Presently 44% of the population (~ 9 million) have access to piped water, 3% have access to hand pump tube wells, 36% has access to safe drinking water through protected dug wells, and 1% of the population uses rainwater harvesting systems. The remaining 15% of the population does not have access to safe water sources[3]. Majority of the water-related health issues are dominant in the dry zone. To resolve water issues prevalent in the dry zone, provision of quality-controlled water supply to villages under National Water Supplies and Drainage Board (NWSDB) surveillance is utmost important. The Government of Sri Lanka (GoSL) is very cognizant of the problem and targets to provide pipe-borne water to the entire nation by 2030. This project conceptualizes how such targets can be achieved.

Activities carried out during the year 2020

The project requires the identification of source/s water to feed the proposed treatment facility. In principle, healthy water requires no or minimal treatments. Therefore, identification of proper water source/s with minimal or no contamination by anthropogenic pollutants is utmost important. However, treatment methods are required to regulate lithogenic (natural) water pollutants. Appropriate methodologies developed to feed water source/s with a sufficient yield. An awareness program on source water protection is developed. Developed an energy minimized, performance enhanced nano membrane filtration (NF) facility to regulate TDS and hardness in water. Parameter's optimization of the model treatment plants' operating conditions to suite environmental conditions in the dry zone is over. Wastes (if any) will be characterized, and membrane-contaminant interactions were examined, and membrane fouling issues were rectified. A hybrid membrane water plant is now operational in Nettiyagama for the village community. The plant operates with low-pressure pumps and the facility functions with solar energy. We also developed a new integrated water quality index for rapid demarcation of water sources.

[2] UN Water Strategy, 2014-2020.

[3] M. Fan (2015) ADB South Asia Working Paper Series 35.

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 mechanisms of the pollutant materials in nature is much more important. Advanced materials such as nanomaterials and composite materials play vital roles in various applications.

Activities carried out during the year 2020

- **Activity 1**
  Synthesis of Nano- zeolite-A (LTA) with the aid of SDS as particle size-controlling Agent
- **Activity 2**
  Synthesis, characterization and determination of the catalytic activity of Fe and Cu modified zeolite **catalysts.**
- **Activity 3**
  Zeolite based catalyst for NOx, SOx reduction
- **Activity 4**
  Surface modification of superparamagnetic Magnetite nanoparticles for bio-conjugation
- **Activity 5**
  Development of rapid lateral flow diagnostic kit for Dengue and COVID- 19

C. Air Pollution & Risk assessment

Project Leader- Dr. G. Bowatte

Introduction to Research Project

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 the burden of disease. In Sri Lanka, air pollution exposure is a neglected health risk for humans. Air pollution is ubiquitous, and the whole population in a given area is exposed. Therefore, even small increases 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 posed on the Sri Lankan economy by air pollution has significant consequences by affecting economic growth and welfare.

Air pollution modelling is used to estimate population/individual level exposures which are important in health risk assessments. The research project at the "Air Pollution Modelling and Health Risk Assessment" group is 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 identify

susceptible groups, high-risk areas, and recommendations to implement policies to reduce pollution. The research of this group will provide evidence targeted at controlling air pollution by implementing policies.

7.2.5. Evolution, Ecology & Biodiversity research project

Project Leader - Prof. Suresh P. Benjamin

Introduction to Research Project

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

Activities carried out during the year 2020

Taxonomic revisions of the jumping spiders of the genera *Ballus*, *Colaxes* and *Marengo* and placement of these genera in the salticid tree of life, description of new species of these three genera were undertaken. Phylogenetic placement and taxonomic description of the Sri Lankan endemic genus *Flacillula* with provisional descriptions of new species including notes on their distribution was completed and submitted to an international journal. Distributional records of Sri Lankan species of the Jumping spider genera *Brettus*, *Cocalus*, *Cyrba*, *Gelotia*, *Phaeacius* and *Portia* completed.

Molecular phylogeny of *Ballus*, *Marengo* and *Colaxes* based on a combined molecular data set of H3+CO1+28S target gene fragments. The phylogenetic analyses were conducted separately for *Ballus*+*Marengo*+*Colaxes* and *Flacillula*. The relevant publication is in preparation.

A study with the objective of gaininhg a comprehensive understanding of the crab spider biodiversity of the island, re-circumscribe genera in phylogenetic terms and placement of these genera in the thomisid tree of life using molecular phylogenetics is ongoing.

7.2.6. Food Chemistry research project

Project Leader – Prof. J.M. Nazrim Marikkar

Introduction to Research Project

The Food Chemistry project at NIFS focuses on exploring the anti-diabetic potentials of the under-utilized bio resources in the country. There are several edible plants that are native to Sri Lanka and the country's agro industrial sector generates several by-products, which are left over after processing. For instance, coconut testa is a by-product of coconut industry, which is currently under-utilized. Hence, Food Chemistry project has initiated number of
research activities in collaboration with Coconut Research Institute of Sri Lanka to explore coconut testa as a raw-material for functional food.

Activities carried out during the year 2020

- **Activity I: Bioactivity studies**
  In this study, bioactivities of different solvent extracts of coconut testa flour (CTF) obtained from different coconut cultivars of Sri Lanka were compared. The overall findings of this study suggest that CTF of all local coconut cultivars could be rich sources of phenolics and flavonoids and had the ability to act as a potential antioxidant and anti-hyperglyceamic agents.
- **Activity II: Physical properties**
  In this study, particle size distribution, physical and functional properties of flour produced from partially coconut testa of four local cultivars namely san raman, gon thembili, ran thembili, TallxTall were compared with those of commercial hybrid.

- **Activity III: Spectroscopic studies**
  In this study, CTF of five different Sri Lankan cultivars, WF and their admixtures were subjected to Fourier transform infrared (FTIR) analysis within the range of 4,000–500 cm^{-1}. The overall findings of this study suggest that CTF and WF exhibited dissimilarities in certain spectral regions due to differences in their proximate composition.

In addition, Prof. Nazrim Marikkar has presented a webinar on diabetes awareness to commemorate the national science week. He chaired the Technical Session on Nutrition and Food Quality at the 32nd Annual Congress of the PGIA, University of Peradeniya, 20th November 2020. Ms. K.M.R.U. Gunarathna, research assistant, presented a paper at the International Conference on Frontiers in Chemical Technology 2020, Colombo, Sri Lanka, 20- 22nd July 2020. She again presented another paper at the International Conference on Dry Zone Agriculture 2020, Jaffna, Sri Lanka, 03-04th December 2020. Ms. S.S.K. Marasinghe, research assistant, presented a paper at the *RESCON-2020* conference of PGIS, University of Peradeniya, 27th November 2020. The project also provided industrial training to Ms. S.A.F. Rushda of Faculty of Agriculture, Jaffna University from 25th August to 5th September 2020. In addition, Fathima Muzni of the Faculty of Applied Sciences, Sabaragamuwa University undertook her final year project from 2020-06-15to 2020-09-25.

7.2.7. Material Processing & Device Fabrication research project

*Project Leader – Prof.*G. R. A. Kumara

Introduction to Research Project

This project involves experimentation and basic studies in the areas of material processing and device fabrication, emphasizing energy conversion and storage, attempting to utilize locally available raw materials. Coconut charcoal and graphite are being innovatively developed as electrodes for solar cells and supercapacitors. Exfoliation and purification of Sri Lankan graphite will be continued with a view to producing oil absorbents and graphene. Also, the project plans to conduct research in the area of thin film perovskites solar cells.

Activities carried out during the year 2020

Issues of long-term stability of dye-sensitized solar cells (DSCs) preventing large scale practical application. Instability originates from photo-degradation of the dye and/or the electrolyte, and evaporation or leakage of the electrolyte owing to imperfect sealing. The latter cause is largely eliminated using high boiling point ionic electrolyte instead of volatiles. The photo-degradation of the dye and the electrolyte happens mainly due to photocatalytic reactions at the TiO_2 surface. Therefore, the work examined the stability of a DSC made of SnO_2/ZnO (ZnO coated SnO_2) working electrode with ionic liquid electrolyte.

The effect of ligands attached to fluorescein on the photocurrent of solid-state dye-sensitized solar cells was studied. The results showed ligand attached to chromophore influenced the absorption properties of dyes. Further, the efficiency of DSCs was enhanced by coupling two dyes.

Spiro-OMeTAD is the common hole conducting material used in Perovskite solar cells (PSCs). However, the cost of spiro-OMeTAD is unbearably high and low-cost activated coconut shell charcoal (ACSC) powder was replaced as hole-conducting material in PSCs. The solar cell made using ACSC powder activated at 950 °C had the highest conversion efficiency of 4.94%.

Transparent conductive films (TCO) are widely used to prepare photovoltaic solar cells and other devices. Transparent and electrically conductive F-doped tin oxide (FTO) thin films were deposited on glass substrates (soda-lime glasses) by sequential nebulized spray pyrolysis. The optical transparency of the films was evaluated by absorption spectroscopy, which revealed more than 65% transparency in the visible regime for the films having 25 Ω cm^{-2} sheet resistance.

In addition, acknowledge the general public, school and university students visited the 'InnoTech 2020-National Innovation and Technology Exhibition' regarding the fabrication and usage of energy conversion and storage methods. Furthermore, trained two undergraduate students and five postgraduate students.

7.2.8. Microbial Biotechnology research project

Project Leader – Prof. Gamini Seneviratne

Introduction to Research Project

The NIFS started research on biofertilizers in the early 1980's i.e. over 35 years ago. The dedicated research of the NIFS first yielded a biofertilizer for legumes called Rhizobial biofertilizer. Then, by 2003, the NIFS invented another product called Biofilm biofertilizer (BFBF) for non-legumes. For paddy, this can cut down up to 50% of all three major mineral fertilizers (NPK) under farmers' practices, and can increase yields by about 20% on average. Field based research trials have been done by the NIFS in collaboration with the RRDI (DOA), Bathalagoda from 2015 onwards. BFBF for paddy has been used commercially from 2016 onwards. Up to now, we have successfully cultivated over 20,000 acres of paddy in areas under the administration of Mahaweli Authority and Irrigation Department, namely Anuradhapura, Polonnaruwa, Ampara, Kurunegala, Mahiyanganaya and Ambalantota.

Activities carried out during the year 2020

Twenty-five field trials of BFBF for paddy were conducted in 5 locations (Anuradhapura, Polonnaruwa, Ampara, Kegalla and Kurunegala) in collaboration with the Department of Agriculture (DOA) during Maha 2019/2020 and Yala 2020 seasons. In 83% of the locations, BFBF practice reported a higher grain yield than the DOA practice. It was also observed that soil carbon sequestration is significantly increased with the BFBF practice, which has implications in carbon trading. In addition, large scale application of BFBF was conducted in 12,500 acres in Kurunegala district alone during Yala 2020 season. This showed a 34% yield increase over the farmers' practice. During Maha 2020/2021 season, new trials were started to compare/demonstrate BFBF practice and DOA chemical fertilizer practice in Batticaloa, Trincomalee, Monaragala and Hambantota districts, 5 trials in each district. Further, the BFBF use has now been expanded in paddy up to 25,000 acres during the current Maha season. In addition, the potential of Biofilm- treated ERP and Feldspar to replace TSP and MOP, respectively is being tested in some of the above districts.

7.2.9. Microbiology & Soil Ecosystems research project

Project Leader –Prof. Renuka Ratnayake

Introduction to Research Project

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, farmlands, home gardens, and small holder cultivations etc. The potentiality of coastal ecosystems such as mangroves and intertidal salt marshes will be studied for capturing and storing 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 maps are the 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 processes to replace commercially available, high-cost enzymes. Another study has been initiated to investigate the genetic diversity of cyanobacteria in different water bodies of Sri Lanka with their taxonomic 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 academic and industrial research but also for future reference.

Activities carried out during the year 2020

Soil Ecosystems- Projects

- **Project 01:** Field soil sampling was carried out as cover-up paddy growing area of the whole Sri Lanka. The collected soil samples were analyzed for the soil carbon content and other macro/ micronutrients. Soil carbon content was mapped across Sri Lanka using statistics of the data in remote sensing and GIS environment.
- **Project 02:** Soil sampling at Mannar Island, Northwestern to the northern coastal belt until Punarin representing mangrove forests, salt marshes, sand dunes, and proximal littoral woodlands. Laboratory analysis to measure soil physio-chemical parameters including Soil organic carbon fractions and available nutrients. Vegetation samples identification and data analysis for Vankalai sanctuary to discuss the current status with respect to carbon fractions and available nutrients.

Microbiology- Project

Sample collection from the extreme ecosystems; salt marshes, mangroves, hot water springs, and lagoons, Sample preparation, isolation, and purification of cyanobacteria. Morphological characterization based on microscopic observations and photographs. Establishment of a biological growth chamber and its regular maintenance. Long term preservation of isolates using cryopreservation. Mass culturing to obtain biomass for further analysis. Analysis of total carbohydrate and total protein contents of dry biomass.

7.2.10. Molecular Microbiology & Human Diseases research project

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

Introduction to Research Project

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

Activities carried out during the year 2020

The main research activities of the year 2020 were based on tuberculosis (TB) and the study of diversity and distribution of thermophilic microorganisms in hot springs of Sri Lanka using molecular genetics. 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. The other four research activities are 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, isolation & identification of halophilic bacteria from Ussangoda cost to be utilized in biotechnological applications and to conduct balloon flights over Sri Lanka to detect possible ingress of cometary microorganisms & particulate matter.

Key findings;

● From the TB research, the list of genes responsible for drug resistance for each first line anti-TB drug were analyzed and mutations that are responsible for drug resistance were identified.

● From halophilic bacterial study, out of 49 moderately and extremely halophilic bacterial isolates, 63% isolates were able to produce extracellular amylases, lipase and proteases.

● Study on hot springs revealed vast diversity of thermophilic microorganisms in hot springs of Sri Lanka, which included a total of
25 phyla demonstrating 131 families with 159 genera. The most abundant bacterial phylum was the Proteobacteria (84.6%-35.2%), followed by Firmicutes (23.7%-0.9%) and Chloroflexi (15.9%-0.4%).

● Study conducted on asbestos related occupational health problems among asbestos industry workers in Sri Lanka, revealed that out of 264 workers of the Asbestos roofing sheets production factory, 64 workers suffered from possible restrictive lung diseases.

7.2.11. Nanotechnology & Advanced Materials research project

Project Leader – Dr. H.W.M.A.C Wijayasinghe

Introduction to Research Project

The Nanotechnology and Advanced Materials Project is involved with targeted oriented fundamental and advanced scientific research leading to the development of Sri Lankan minerals and related materials. It focuses on nanotechnology and advanced industrial applications, such as energy storage, water purification,

nanomaterial synthesis and vale addition to raw materials for high-tech industrial applications

Activities carried out during the year 2020

The ceremonial opening of the National Center for Advanced Battery Research (NCABR.) took place in January 2020. This is a national facility open to research groups related to local material development for energy related applications. The development of Sri Lanka Graphite for rechargeable batteries is a major research area of this center. Under this, a number of research projects are carried out in collaboration with local universities

7.2.12. Natural Products research project

Project Leader – Prof. U.L.B. Jayasinghe
Prof. N.K.B. Adikaram

Introduction to Research Project

The overall objective of the Natural Products Project 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, including the Stem-end Browning, and three physiological disorders, Fruit pitting, Lenticel Darkening and the Internal Pulp Browning of mango var. TomEJC, an export-oriented fruit crop.

Activities carried out during the year 2020

Investigation of extracts from plants and, metabolites of epiphytic and endophytic fungi, as potential sources for the use in agriculture and human health; Chemistry and bioactivity of edible fruits, Plant secondary metabolites and LC-MS profiling of bioactive extracts and Study of the cause/s and management of postharvest diseases and disorders that adversely affect the export potential of mango var. TomEJC.

I. Chemistry and bioactivity of fungi associated with medicinal plants, & edible fruits

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

II. Enzyme inhibitors from plants

Of the 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**), the Compound **1** showed the highest AChE inhibitory activity and antioxidant activity while the Compound **2** displayed the most potent *α*-glucosidase inhibitory activity. This is the first report of *α*- glucosidase inhibitory activity of Compound **2**. Results indicate that the aril of *M. fragrans* showed good anticholinesterase and *α*-glucosidase inhibitory activities and antioxidant effect *in vitro* that have a potential to be used as a treatment for Alzheimer's disease.

III. Fungal Metabolites

Secondary metabolites were isolated from an endophytic fungus *Biscogniauxia capnodes* and identified, by Chromatographic separation of the extract which furnished 2 isocoumarins, reticulol (**1**) and 6-*O*- methyl-reticulol (**2**), and two dihydroisocoumarins, 5-methylmellein (**3**) and 7-hydroxy-5-methylmellein (**4**). Compound **1** showed moderate antioxidant activity against DPPH radicals. 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*.

IV. Postharvest diseases and disorders of mango var. TomEJC

Eleven fungi were shown to be associated with the Stem-end Browning (SEB) which were subject to molecular identification and confirmation of pathogenicity. Pre- and postharvest management strategies were determined and recommended. Fruit pitting was shown to be due to deficiency of some elements through ICP analyses. 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 shown to be related to some physiological and weather factors.

7.2.13. Nutritional Biochemistry research project

Project Leader –Dr. Ruvini Liyanage

Introduction to Research Project

Food is one of the basic needs of a human being. Consumption of unhealthy, unsuitable food is one of the main causes of disease and disorders amongst Sri Lankans. By understanding the nutritional requirements of Sri Lankans at a cellular and molecular level this project aim to make our country healthier and more nutritionally sufficient. To achieve this objective Nutritional Biochemistry project is focused in several areas of research, including functional and nutritional properties of food, food safety, and bioavailability of food to improve health and well-being of people. Chemical properties of nutrients and other dietary constituents and their biochemical functions are studied to understand the interactive relationship between diet and health.

Activities carried out during the year 2020

In 2020, Nutritional Biochemistry Project focused mainly on two projects as described below.

I. 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 nutritional, functional and physicochemical properties of some starches, mushrooms and raw and processed *Artocarpus nobilis* seeds.

II. Bioavailability and bioaccessibility of food bioactive compounds: One of the important characteristics of classic foods and, in particular, functional foods is the bioefficiency, which is the ability of food to meet the metabolic needs of the consumer. Quantitative expression of food bioefficiency is done using other concepts, such as bioavailability, bioaccessibility, and bioactivity of food components. These concepts can be studied by *in vivo*, *ex vivo*, and *in vitro* methods, and can be expressed quantitatively by different units of measurement. In this study, bioavailability and bioaccessibility of nutrients and antioxidant compounds in legumes have been studied.

Published several research articles in SCI/SCIE journals and one MPhil study was completed.

7.2.14. Plant & Environmental Sciences research project

Project Leader –Prof. M.C.M. Iqbal

Introduction to Research Project

The two major research divisions in this division are Plant Tissue Culture and removal of pollutants from the environment. Plant tissue culture research is concerned with micropropagation of plant species important for humans and for the conservation of our forests. We also teach school children and the general public on how to undertake plant tissue culture.

Our environment has many pollutants coming from industrial activities and from agriculture. We are concerned with textile dyes that are discarded from small and medium scale industries (SME). These small industries cannot invest in expensive pollutant removal methods. We have developed adsorbents to adsorb dyes from wastewater, using readily available natural resources.

Intensive agriculture results in the use of excess chemical fertilizers (phosphates and nitrates), which are leached into our waterways and irrigation tanks. This results in the phenomenon called eutrophication. We have identified plants to remove these chemical compounds using water plantsand recycle them as fertilizer.

Activities carried out during the year 2020

Under plant tissue culture we developed a tissue culture method to propagate the Stevia plant. This plant produces a natural sweet substance which is more than 300 times sweeter than sugar without any calories! This is in demand in the food technology industry to produce food items for diabetic patients. Our main concern is to propagate tree species for replanting in the dry zone. Trees in the dry zone forests produce seeds seasonally after the rains and the seeds are difficult to germinate. Through tissue culture a large number of planting material can be produced. We have developed tissue culture methods to propagate Mee and Palu. While we were able to develop shoot cultures of both these species, rooting was difficult; however, we have now induced root development from Mee tissue cultures. In addition, we have

successfully developed methods to break seed dormancy for these species.

Adsorbents were developed using commonly available kaolin clay and chitosan (available from crustaceans) to absorb textile dyes from water. In addition, composites were synthesized from feldspar, agar and alginate to adsorb phosphates from wastewater. Methods were developed to absorb phosphates from farm effluents using the water plant pistia.

7.2.15. Plant Stress Biology & Molecular Genetics research project

Project Leader –Prof. S. Seneweera

A. Creating global benchmark yields in paddy and minor crops

Introduction to Research Project

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 are not well understood. 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 have not been 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.

Activities carried out during the year 2020

We have obtained breeder seeds of 20 local rice varieties available in RRDI, Bathalagoda, 11 local rice varieties from Ambalanthota and Labuduwa, 50 traditional varieties from PGRC and 10 international varieties and have multiplied for seed germination. DNA is being extracted from the 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. Another set of 96 traditional Sri Lankan rice cultivars maintained in Japanese genbank have been obtained and started their multiplication. The field trial in the Maha season, 2020/2021 has been initiated. The purchasing of 7 laboratory instruments including microwave oven, pH meter, -20 freezer, vortex machine, temperature-controlled microcentrifuge machine, shaking water bath and cryo express dry shipper has been processed.

B. Develop plant demand-based nitrogen fertilizer using hybrid nanomaterial

Introduction

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, volatilization of ammonia etc. Extensive use of N fertilizers results in excessive emission of N_2O which is one of the major greenhouse gases 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 a way that it releases nutrients in a controlled manner which synchronizes with the needs of plants. Therefore, we are aiming to develop an environmentally friendly, cost effective, biodegradable, controlled release nano fertilizer system with high nitrogen use efficiency.

Activities carried out during the year

Synthesis of nanocomposites

1) Synthesized nano fertilisers using cation exchange capacity (CEC) intercalation method and mechanochemical intercalation methods.
   A) Cation exchange capacity (CEC) intercalation method Synthesized fertilizers using the technique of CEC. Also, by using surfactant chemistry techniques intercalated anionic species to the carrier materials.
   B) Mechanochemical intercalation method
   With the help of diskmill apertures synthesized different types of slow-release fertilizers
2) Characterized each synthesized material by using FTIR, XRD, and TGA methods
3) Water base releasing studies were carried out using three different mediums including water, desorption solutions and different ionic strength solutions

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 focuses 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. The government of Sri Lanka is planning to increase the natural forest cover from the current 29.7% up to 32%. Assisted natural regeneration (ANR) is one of the important methods selected for restoring forest cover in degraded areas. NIFS-Sam Popham Arboretum (NIFS-SPA) is considered as the best site in Sri Lanka for ANR. On account of its significance as a benchmark site for Assisted Natural Regeneration, many forest ecologists and botanists use NIFS-SPA as a research site. It is also a popular tourist destination owing to the presence of unique fauna with a rich bird life and some unique animals such as Slender Loris and Pangolin. NIFS- SPA also has dry evergreen rich vegetation consisting of over 200 species of trees. One of the main tasks of this project is to develop this important arboretum. Research activities on natural products from medicinal and invasive plants were carried out in collaboration with Universities of Peradeniya and Jayawardenapura. Work related to the compilation of the National Red list for flora was continued with the assistance of expert teams conducting meetings at the National Herbarium.

Activities carried out during the year 2020

One of the main tasks of the Plant Taxonomy and Conservation project is to develop the NIFS-Sam Popham Arboretum. The woody vegetation in that arboretum was

mapped on a GIS map and research on regeneration and soil microbiology are continuing. The interpretative signage including maps and informative panels on both flora and fauna within the arboretum was established and the bridges and foot paths were upgraded.
Studies on phylogenetic studies of two important genera, *Syzygium* and *Strobilanthes* are continued. During the field visits many interesting Syzygium species were located. DNA analyses were conducted on selected specimens. All the collected specimens were prepared as voucher specimens and deposited in the National Herbarium. Among the floristic zones, Foothills of Adam's Peak and Ambagamuwa has the highest species richness, whereas dry zone is the lowest compared to *Strobilanthes* recorded zones. The pollen morphology of Genus *Strobilanthes* from Sri Lanka using scanning electron microscopes were continued. Work related to the compilation of the National Red list for flora was completed with the assistance of expert teams conducting meetings at the National Herbarium.

Research activities on natural products from medicinal and invasive plants were carried out in collaboration with Universities of Peradeniya and Sri Jayawardenapura. A survey was conducted on a newly introduced invasive grass, *Panicum tricocladus*.

7.2.17. Primate Biology research project

Project Leader –Prof. W. Dittus

Introduction to Research Project

The research program involves observational studies of monkeys (primates) in their natural forest habitats. Our "laboratory" is the Polonnaruwa Nature Sanctuary (cum Archaeological Reserve) where we have established the empirical foundations for our research over several decades. The research subjects involve mostly the endemic toque macaques (*Macaca sinica*) but also the purple-faced langur (*Semnopithecus vetulus*), gray langur (*S. priam*) and
slender loris (*Loris lydekkerianus*) Our aims are: (1) to contribute new knowledge to the understanding of the evolution of social behavior in primates (and by extension in humans); (2) to provide a scientific basis for the effective management and conservation of primates and other organisms; and (3) to disseminate new knowledge through scientific publications as well through professionally produced documentary films with an eye towards - not only educating and entertaining, but also gaining public support for conservation efforts in the local and international communities. Our films contribute positively to the image of Sri Lanka as a tourist destination. Our research results are published mostly in quality SCI journals.

Activities carried out during the year2020

I. Observational field research aims to clarify comparative demography and behavioral ecology of four species of sympatric primates at Polonnaruwa: toque macaque *Macaca sinica*. gray langur *Semnopithecus priam*, purple-faced langur *S. vetulus* and nocturnal loris *Loris lydekkerianus*. Methods involve regularly scheduled census of 5 to 18 social groups of each species. Routine monitoring yield information on rates of birth, death and emigration (between group transfer) and group fission in relation to age-sex, social rank, reproductive condition and ecological factors. Long-term data are needed for analyses of highly variable trends that are applied for testing hypotheses of behavioral ecology and evolutionary adaptation as well as conservation strategies. Researchers: Mr. Chameera Pathirathna, Mr. Sunil Rathnayake, professionally certified naturalist staff of the Association for theConservation of Primate Diversity (ACPD), Polonnaruwa with assistance from Mr. Kapila Hewananda.

II. Primate phylogeny studies involve field monitoring the socioecology and demography of hybrid primates between *S. priam* and *S. vetulus*, and the

collection of DNA samples for phylogenetic analyses. Researchers: ACPD staff in collaboration with Prof. S. Benjamin (NIFS) and Prof. P. Karanth (Indian Institute of Science).

III. Dissemination of science to the general public by way of scientific consultancy and logistic support of professional film crews that develop documentary films that are broadcast internationally (BBC Natural History).

IV. Editorial Consultancy. Review of scientific articles submitted to journals: *International Journal of Primatology, Journal of Threatened Taxa, Folia Primatological, Human Dimensions of Wildlife*

V. Data analyses. (a) Data record management by scanning up to 52-year- old research records into digital format and uploading to the cloud. Transcribing some into digital spreadsheets for easier compilation. (b) Analyses of cheek-pouch use (an anatomical adaptation unique to cercopithecid primates) in relation to ecological variables such as diet, age and sex and social rank. (c) Initiation of analyses of approximately 1,200 records of dental development in wild toque macaques with the assistance of a volunteer participant Tharangi Hettiarachchi. (d) Preparation of a publication regarding wildlife electrocutions and conservation management.

7.2.18. Quantum Physics & Applied Electronics research project

Project Leader –Prof. Asiri Nanayakkara

Introduction to Research Project

The Quantum Physics research group at the NIFS was initiated in January 2016 and is currently engaged in investigating the fundamental aspects of Quantum to Classical Transition, Quantum chaos, Quantum Computing and Quantum non-locality. This research unit consists of projects under the areas of foundations of quantum mechanics and single bubble sonoluminescence. The sonoluminescence research group is involved in carrying out theoretical and experimental investigations to understand the light emission mechanism in single bubble sonoluminescence, one of the major unsolved problems in physics.

Why does this matter?

Quantum phenomena explain many of the properties of electrons, protons, neutrons etc. Applications such as semiconductor electronics rely on Quantum Physics. Even 100 years after its inception, the fundamental aspect of quantum mechanics is one of the most dynamic areas of current physics research. Fundamental research on Quantum Non-locality, Quantum Entanglement and Quantum to Classical Transition is not only important in understanding the true nature of the Quantum reality but also their existence has practical consequences, enabling much stronger forms of information processing, communication and quantum computing.

Currently, investigations are underway in our laboratory on wave function collapse due to classical and quantum interactions, new types of quantum correlations without entanglement, quantum double slit experiment, single bubble to multi-bubble transition in sonoluminescence, single bubble sonoluminescence in radon dissolved water and the light emission mechanism in single bubble sonoluminescence.

7.2.19. Rhizobium research project

Project Leader –Prof. S. A. Kulasooriya

Introduction to Research Project

Rhizobia are soil bacteria that form endosymbiotic root nodules in leguminous plants which fix atmospheric nitrogen and provide it to the host plants. A number of food legumes like soybean, mung bean, groundnut, vegetable bean etc are common food

legumes grown in Sri Lanka. In this project we isolate, characterize, identify and authenticate rhizobia from different food crops, screen and select the efficient strains and prepare carrier-based inoculants with them. These inoculants are supplied to crop cultivators to improve nitrogen fixation in these crops and minimize the application of N-fertilizers (urea) to them. These inoculants are capable of completely replacing the addition of urea without any reduction in yields.

Activities carried out during the year 2020

For the Yala season 2020, rhizobial inoculants were supplied to 3,600 acres of soybean, 150 acres of mung beans and 1,000 packets to be used for the planting of 1000Kg of vegetable beans. New rhizobial isolates from mung beans were used for the preparation of improved inoculant formulations and new field trials commenced to test these formulations. Rhizobium biofertilizers were supplied to 250 acres of vegetable bean cultivation, and 100 acres for seed production of soybean to be used in the Yala 2021 season. Farmer demonstrations were held jointly with the Central Provincial agriculture ministry to expand bean cultivation with Rhizobium inoculation. Our field activities got severely restricted due to the Covid-19 pandemic.

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 allows farmers to create virtual fences using computer software, while the GPS collars are programmed to emit an aversive signal automatically when the animal reaches virtually fenced boundaries. This recent advancement in virtual fencing technology has the potential to revolutionize the management of human elephant conflict but requires field- testing and refinement. This project tests the AGD technology on captive elephants at Pinnawala Elephant Orphanage to determine its effectiveness in managing elephant movement. If successful, AGDs will then be tested on wild elephants to determine its effectiveness in managing elephant movement around human habitations.

Activities carried out during the year 2020

During year 2020 preliminary behaviour of three new captive elephants (in addition to the nine selected last year) were observed and fresh fecal samples were collected from all 12 elephants from which cortisol hormone (the hormone used as an indicator of physiological stress) was extracted. Stageone experiment was conducted with four elephants using a dog training collar, which delivers mild electric stimuli at various strengths. Elephants were fitted with a dummy collar for three days prior to the experiment allowing them to acclimatize to the collar. On experiment days, this was replaced with the shock collar. After the experiment the shock collar was removed and their wellbeing was monitored for three to six consecutive days with or without the dummy collar on. Fresh faecal samples were collected from the elephants before, during, and after the experiments to determine cortisol levels. Behavior of all

elephants tested were observed between 0800–1600 h for a total of one hour per day per animal) to obtain a general sample of behavior shown by each animal during daytime. Behavior were observed during the pre-experimental period, when the elephant was wearing the dummy collar and on all experiment and post experiment monitoring days. Welfare outcomes in response to warning signals will be determined by studying the behavior and physiology of the elephants.

7.3 Contribution towards National Development

The NIFS is mandated to conduct fundamental research. Globally, the benefits of fundamental research to society are not immediate. For example, over two decades of fundamental research in molecular microbial biotechnology, have led to scientific discoveries that have transformed into application science, producing biofilm fertilizers as an alternative to chemical fertilizers direct annual saving over LKR 9 billion. Further, there are unquantifiable health and environmental benefits, as well. Our scientists have also successfully conducted research into high-end technology development, particularly in value addition to national mineral resources. For example, seven graphite-based materials and energy devices have been patented locally but have large global market potential. Currently, we have over one hundred postgraduate students in any given year going through our training process, through which we have substantially reduced foreign exchange moving out of the country and reducing brain drain. The instrument facility at NIFS with in house maintenance will be declared as a resource for the entire nation. NIFS continues to promote dialogue amongst peers via research conferences and symposia. The Institute also fosters public understanding and social outreach of science via a dedicated digital channel.

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

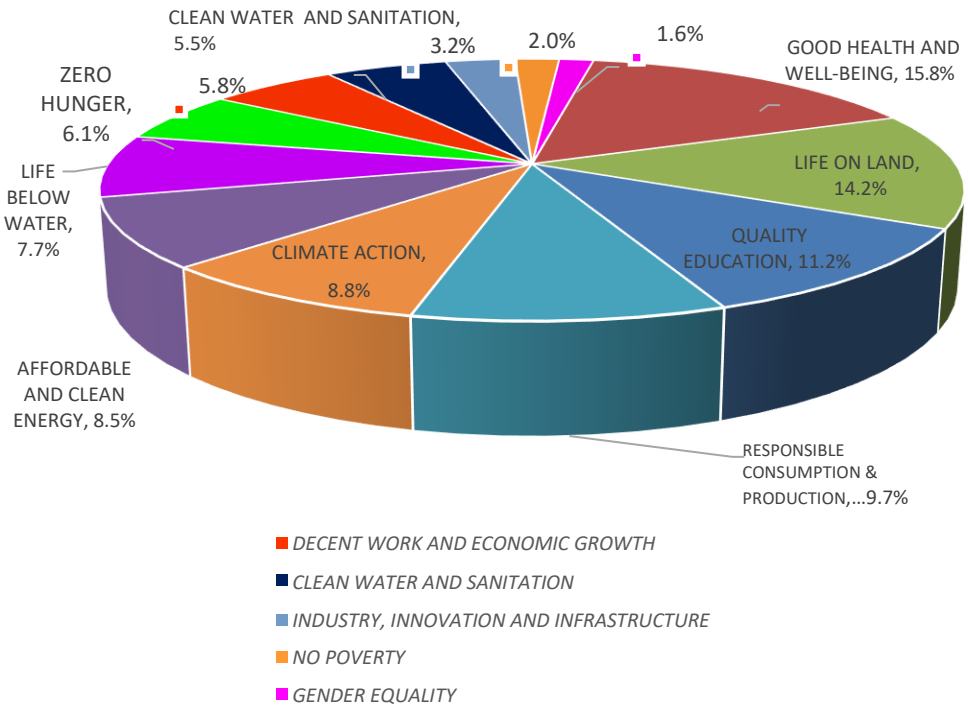
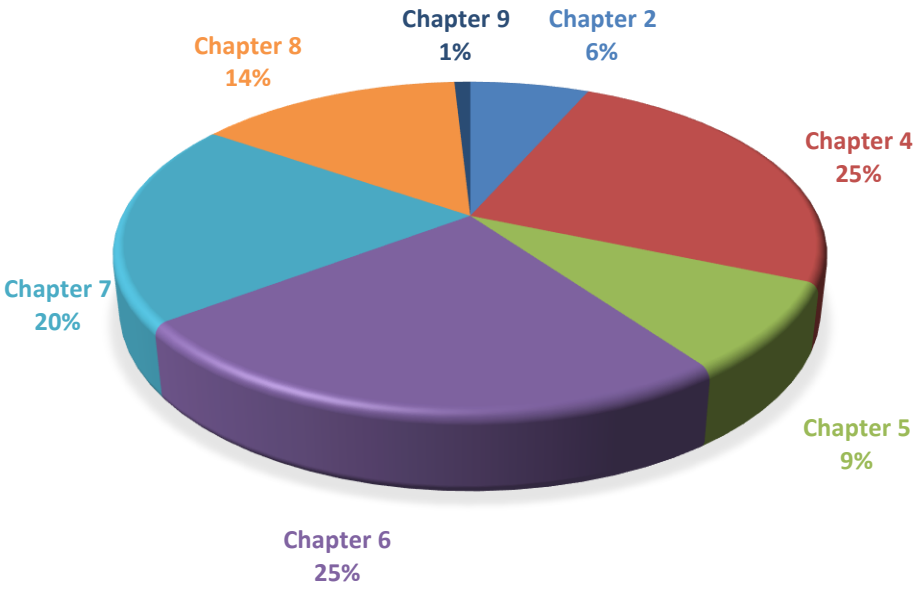


Figure 1. Achieving Sustainable Development Goals (SDGs) in 2020



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

Figure 2. NIFS contribution towards National Policy Framework on Vistas of Prosperity and Splendour 2020

Developed Solutions to address current issues in the country by NIFS research projects are given below;

7.3.1 Condensed Matter Physics & Solid-State Chemistry research project

Contributed to design and develop a sodium hypochlorite solution disinfection system by Prof. Kumara's group to be used to disinfect floor areas of buildings against Covid-19 spread (several units were fabricated and some handed over to the Vidatha Centres under the Ministry).

Project Leader Coordinated as a Deputy Director of the National Solar Panel project of the Ministry towards locally manufacturing thin film solar panels and developed programmes with Sustainable Energy Authority and NAITA for the training of Solar Technicians at NVQ 4/5 levels.

7.3.2 Earth Resources and Renewable Energy research project

Discussions have been initiated to commission the first ever geothermal power plant in Sri Lanka. If successfully built, this will help reduce the carbon dioxide emissions and the cost of importing coal. Further, as the geothermal energy is a reliable and stable source of power, this can be added to the power grid as a base load, improving the renewable energy share of the country's power generation.

Thermoelectricity project has developed a small portable thermoelectric charger that can charge a mobile phone or a portable mobile device using a small tea candle or oil lamp. This device is especially useful when no other source of electricity is available, for example in remote areas without electricity or when solar power is not available, camping, during power failures, or camping or outdoor activities. Scaling up of this device may allow us to use any source of waste heat or renewable heat source (e.g. biomass) to generate power-on-demand.

7.3.3 Energy & Advanced Material Chemistry research project

Fabricated a mini reactor for the separation of oil from the service- station wastewater and the project will carry out the final trials in next year.

7.3.4 Environmental Science Research Programme

A. NIFS Water Research Project

Development of community water supply based on membrane methods with near zero wastes. The treatment method does not use any chemicals, and the unit is automated, hence no village interventions are needed. Water quality matches with the Kandy region drinking water quality. The wastes are blended to meet stringent needs, and used in wash rooms and gardening.

B. Materials development & pollution remediation

Significant scientific research findings and inventions during 2020:

- Nano Zeolite from environmentally friendly way
- Zeolite based catalyst
- Vehicle exhaust controlling system
- Higher fluorescence nanomaterials
- Lateral flow diagnostic kit for dengue
- Test kit development for COVID -19

7.3.5 Evolution, Ecology & Biodiversity research project

During the past year, through the research efforts of all project members, 104 species of spiders new to science were discovered. This highlights the biological heritage of Sri Lanka.

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

7.3.6 Food Chemistry research project

During the year, research focus was given to utilize coconut testa left over by coconut processing industries in Sri Lanka. At a time, there is a dearth of nuts to produce sufficient amounts of coconut oil for local consumption, it is worth to exploit coconut testa for oil production and use the residue for flour. As wet coconut testa constitutes

around 18% of the kernel weight, an estimated 30,000 Kg of testa would be produced out of 100,000 nuts. 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, the economic value of coconut would be enhanced through by product utilization.

7.3.7 Material Processing & Device Fabrication research project

Public places like hospitals, schools, public transportation services and quarantine centers face the biggest problem of disinfection of the large areas contaminated with the coronavirus. Therefore, the expenditure to pay for cleaning solutions are quite high. As a solution for this, we invented the machine to produce sodium hypochlorite solution using salt water which can be prepared by a simple low-cost method. This infection solution is made by dissolving salt in softened water, resulting in a concentrated brine solution. Then the solution is electrolyzed using two graphite rods to form a Sodium Hypochlorite solution. Then, the machines that produced this Sodium Hypochlorite solution were delivered to the hospitals island-wide.

7.3.8 Microbial Biotechnology research project

The expansion of BFBF use up to 25,000 acres of paddy cultivation during the on-going season will save imported chemical fertilizers worth of ca. 50 million rupees by cutting them down, and also will provide farmers an additional income of ca. 375 million rupees through the yield increases. This will save foreign exchange spent on importing chemical fertilizers for other important matters during this crisis period. Also, increased income for the farmers will help reduce poverty for them.

7.3.9 Microbiology & Soil Ecosystems research project

- A cyanobacteria culture collection has been established for the purpose of research, education, and industrial purposes.
- Collection of baseline information for future C trading programmes
- A GIS-based map has been prepared to show the distribution of soil C and other nutrients in the Knuckles forest region
- Nine agricultural land uses in Northern Sri Lanka has been covered for soil fertility and biological parameters. This is the first detail soil survey conducted in the Northern part of Sri Lanka after 1987

7.3.10 Molecular Microbiology & Human Diseases research project

In treatment of multi drug resistant tuberculosis, the importance of using personalized medicine (Whole genome sequencing) was identified.

7.3.11 Nanotechnology & Advanced Materials research project

Stablishing of the National Centre for Advanced Battery Research (NCASR) under this project at the NIFS. The ceremonial opening of the NCABR took place in January 2020. This is a national facility open to research groups related to local material development for energy related applications. The development of Sri Lanka Graphite for rechargeable batteries is a major research area of this center. Under this, a number of research projects are carried out in collaboration with local universities.

Further investigations on scaling-up of our patented innovations on local graphite have been carried out in order to support their commercialization. Moreover, prototype development of bigger battery types such as pouch cells using our developed materials have been commenced to support possible local manufacturing of it.

7.3.12 Natural Products research project

Proper understanding of the cause of postharvest disease and disorders help development of appropriate management practices. Overall, the outcome of the

project significantly reduced the loss of good quality fruits to be harvested, increasing availability of exportable mango fruits.

7.3.13 Plant & Environmental Sciences research project

- The plant tissue culture protocol to micro-propagate Stevia plants is available for commercialization to interested entrepreneurs.
- Adsorbents are available to remove textile dyes from wastewater in small and medium scale textile dyeing industries.
- A simple method to recycle phosphorous from animal farm effluents is available using water plants.

7.3.14 Plant Taxonomy & Conservation research project

Project leader was involved in the preparation of the national Policy for Conservation and Sustainable use of Mangroves of Sri Lanka. The Policy was launched in 2020.

7.3.15 Primate Biology research project

- Project leader was invited by the Ministry of Environment to participate as a consultant expert regarding the National Scale Up Plan for Environment Sensitive areas (ESAs).
- In Sri Lanka (and globally) wildlife is subject to many threats arising from the conversion of natural environments for human use. One threat involves electrocution of arboreal animals from power lines. Over a period of 24-35 years we have developed and tested methods that successfully prevent primate deaths from electrocution.

7.3.16 Rhizobium research project

The country after Covid-19 is facing severe difficulties in spending foreign exchange for the import of chemical fertilizers. The uncontrolled application of reactive nitrogen fertilizers (subsidized urea) is also causing environmental pollution that is contributing to environmentally related illnesses such as kidney diseases and cancer. The application of urea to legumes crops can be replaced completely by the use of rhizobial inoculants without any reduction in yield. The widespread use of our inoculants can not only save foreign exchange but also minimize environmental pollution.

7.3.17 Aversive Geofencing Technology to Mitigate Human-elephant Conflict

Our results show that electric stimuli from the collar were able to generate aversive responses from captive elephants. It is also observed that the elephants only show acute physiological and behavioural stress responses and do not show any long-term changes in their physiological stress or behaviour. These promising results suggest that relatively mild aversive stimuli may be sufficient to produce aversive behaviours in the field, though this requires exploration. The results obtained so far shows that aversive geofencing devices have the potential to constrain elephant movement with minimum welfare impacts on the animal.

7.4 National Centres for Research & Development

A. National Centre for Advanced Instrumentation

The centre can provide services to all researchers at the NIFS through an online booking system and to fellow researchers at other research institutions and universities in Sri Lanka and abroad. The centre can also train interested students in Instrumentation and conduct M.Sc. Programmes in Instrumentation. The centre can be made open to school children in science streams to visit through prior appointments to gain knowledge on advanced instruments and even arrange hands-on practices as well. The centre can also cater to industries as an Analytical Service after obtaining necessary accreditation.

B. National Centre for Water Quality Research (NCWQR)

Water is a bizarre molecule! Most of the water researchers advance knowledge in water policy, management, treatment, and pollution control. However, the NCWQR will be aimed at addressing fundamental scientific problems in all aspects of water research. The Centre for Water Research, CWR frontier research spans from water quality issues that require fundamental components to address. The ZNCWQR research scientists have a strong synergy between the NIFS research groups to harmonize ecological, economic, and social interests in water usage. The NCWQR will strengthen collaborations with other laboratories who are pursuing fundamental aspects of water quality research. We also foster a partnership with Water State Ministries, national universities, research institutes, industry, and international organizations to minimise overlap.

C. National Centre for Advanced Battery Research

This is a dedicated central laboratory facility for battery-related research and development work. The highest priority of this centre is given to the development of Sri Lankan minerals to fabricate novel low-cost but high performing batteries, locally. This central laboratory facility is currently open for local research groups working on battery and energy-related applications to perform collaborative research activities. At present, our laboratory/testing facility ranges from materials synthesis, component fabrication, cell assembling to battery performance evaluation.

D. Centre for Advanced Research on Nitrogen Management in Agriculture (CARNMA)

After decades of research, the NIFS has developed ***Biofilm biofertilizers*** and ***Rhizobium biofertilizers*** to minimize the use of chemical fertilizers, nitrogen in particular in agriculture. Now, these products are applied in thousands of hectares in crop production, thus saving human and soil health, and also foreign exchange. The NIFS can therefore claim to be an institute to have developed technologies that could contribute to reaching the SDG of reducing N-waste by half by the year 2030. Also, over past three decades, NIFS scientists have contributed immensely to understanding various fundamental aspects of nitrogen in the environment. The objective of CARNMA is to conduct research and development activities on a wider scope including water quality, soil carbon sequestration, climate change, food and nutrition, sustainable use of biodiversity etc. and this is implemented by a highly qualified and experienced group of scientists with diverse expertise.

E. National Centre for Renewable Energy

As a country without major fossil fuel resources, we are heavily dependent on imported fossil fuel for our energy needs. Developing renewable energy sources, as well as improving the efficiency by inventing new technologies and energy storage solutions will help ease the economic burden of fossil fuel imports as well as the environmental issues such as air pollution. At the NIFS, many research projects are

conducted to develop renewable energy sources as well as to improve the efficiency of the existing energy transformations. With the above objectives in mind, a National Centre for Renewable Energy was recently established at the NIFS.

F. Biofilm Biofertilizer laboratory

This is the only lab in the country dealing with biofilm applications in agriculture and plantations, Biofilm biofertilizer in particular. The lab has all requirements for developing biofilms, their testing for efficacy, and also formulating Biofilm biofertilizers for non-legumes. Quality control of Biofilm biofertilizers manufactured in the industry is also done in this lab. The lab also has a microbial mother culture collection used for producing Biofilm biofertilizers for various crops in the country.

G. Rhizobium Inoculum laboratory

Rhizobia are free-living, heterotrophic soil bacteria which can form symbiotic root nodules with many leguminous plants which enable them to fix atmospheric N2. This laboratory is specialized to isolate, characterize, screen and select efficient rhizobia and prepare inoculants to be used as biofertilizers in agriculture.

H. NIFS-Popham Arboretum

An arboretum, in a general sense, is a collection composed exclusively of living trees. Arboreta are usually developed by planting trees, but the NIFS Sam Popham's arboretum has been developed using a method known as Assisted Natural Regeneration (ANR). The NIFS-Popham Arboretum was founded by Mr. F H (Sam) Popham in 1963. He bought a seven and half acre-land of scrub jungle to initiate the arboretum. This arboretum was gifted to the Institute of Fundamental Studies (IFS), Kandy in 1989. The arboretum now has 34.5 acres with the addition of 27 acres in 1989, through the initiative of Prof Cyril Ponnamperuma, a former IFS Director.

What can you do at the NIFS Popham Arboretum?

- Nature awareness Programmes: Our main aim is to educate the future generation on how to protect and preserve nature. Special programmes are organized for local/international universities, schools or other interested parties (day-outs for private companies etc.). These programmes mainly focus on dry zone vegetation, forest restoration, wildlife and conservation ecology and traditional use of forests. With our guidance, enjoy trees, learn how to identify, select and care for them.

- Safari at NIFS Sam Popham's Arboretum: At day safari, visitors can walk through all nature trails with or without a guide during day time (8.00 am- 6.00pm). Visitors can walk through all nature trails with or without a guide. Four nature trails (Green trail, blue trail, pink trail and yellow trail) have been set up for day time walks. These trails are marked and well maintained with colour bands and numbered arrows for self-navigation around the arboretum. Day walks are ideal for bird and butterfly watching, viewing forest trees & mushrooms and for a forest bathing experience. Day walks are open from 8.00 am to 6.00 pm every day. Night safaris mainly focus on Grey Slender Loris (*Loris lydekkerianus*) and Pangolin (*Manis crassicaudata*) watching. Walks are arranged with a tour guide and open form 7.00 pm to 10.00 pm.

- Research at the NIFS Sam Popham's Arboretum: Depending on the researcher's interest, projects can focus on dry zone vegetation, restoration ecology, animal behaviour, microorganisms, carbon sequencing and taxonomic studies on flora and fauna.

I. Smithsonian Primate Research Station and Reserve

The research station and reserve are located in New Town, Polonnaruwa (see Google maps), and serve as a center for education outreach and logistic support for scientists and lay persons interested in the study, appreciation, and conservation of nature with a particular emphasis on primates. It is known locally as the "monkey camp" and is the outgrowth of a facility first established by scientists of the Smithsonian Institution in 1967 and has been developed further since then by Prof Wolfgang Dittus. The center is nested in a remnant patch of natural dry-zone forest, approximately 7 acres in extent, on the shores of Lake Parakrama. It is administered and supported by the Association for the Conservation of Primate Diversity (ACPD); a non-profit company registered in Sri Lanka. It has served as the focal point for numerous studies by international and national investigators and students as well as many crews to produce documentary films that exalt Sri Lankan nature.

As natural areas give way to suburban expansion at Polonnaruwa, the small reserve has increased its worth as critical habitat for a variety of endemic and migrant birds, small mammals, fish, reptiles and amphibians, as well as for the slender loris (*Loris lydekkerianus nordicus*), which has the highest known density for this species at this site. It also serves as a refuge of the larger primates and even the occasional elephants in the area. A breeding colony of waterfowl occupies "bird island" near the shores of the center and is under study by center naturalists.

The center offers accommodations for visitors and professionally guided educational tours of the four species of primates in the Polonnaruwa Nature Sanctuary, the toque macaque (*Macaca sinica*), grey langur (*Semnopithecus priam*) and purple-faced langur (*S. vetulus*). Evening tours highlight the nocturnal loris, civets, mouse deer and elusive fishing cat. Bookings for accommodations and/or tours can be made through www.primates.lk.

7.5 Progress of the Office for Research Support (OFRS)

The Office for Research Support (OFRS) was first established on the 1st of April 2019 and now it functions as the supportive arm of the NIFS in delivering research support services related to research grants, research development, research education and research collaborations with other institutes. We work closely with the academics, research assistants and the Science Education and Dissemination Unit (SEDU) of NIFS to provide high level administrative support to manage their research activities.

Performances of the Division

- As the major role of the OFRS, management of research grants was conducted throughout the year. A major research grant proposal; Korea International Cooperation Agency (KOICA) concept proposal was submitted through the OFRS and it has been accepted to the second stage and the NIFS was invited to submit the full proposal for 2022. Apart from that, OFRS reviewed and coordinated submission of 20 research grant proposals submitted by the scientists of NIFS to different funding agencies and an archive of the submitted grant proposals are also maintained by the OFRS. OFRS also Coordinated with the National Research Council for two mega research grants. During the first and second waves of the COVID-19 pandemic, OFRS liaised with the line ministry to obtain funding to carry out the COVID- 19 Related projects of the NIFS; Developing and introducing Sodium Hypochlorite Generators, ventilator repairing and rapid test kit for detection of COVID -19. Coordinating the internal research infrastructure grant proposals for 2021was also done by the OFRS.
- In 2020, coordination of signing of four MOUS with two universities and two industry partners was done by the OFRS. A research collaboration with the Center for Yunnan Plateau Biological Resources Protection and Utilization, Qujing Normal University, China was also initiated by the OFRS together with Prof. Siril Wijesundara, Research Professor NIFS. In 2020. OFRS coordinated submission of two patent applications, obtained training in patent search and patent drafting by participating in two training workshops organized by the World Intellectual Property Organization and the Ministry of Science, Technology and Innovation.
- The OFRS provided support and guidance to the Young Scientists Association in organizing the Three Minute Thesis Competition 2019 and National Conference on Multidisciplinary Research 2020 and two capacity building workshops were also conducted for the research assistants of the NIFS on How to increase the visibility of your publications and promote your research by Prof. Nalin Wijewardhane and on How to write an outstanding abstract by Prof. M.C.M. Iqbal. To increase the research visibility of NIFS, OFRS produced three issues of the NIFS newsletter which was circulated among the staff members and of “NIFS Research bulletin” which was circulated among the academic institutes in Sri Lanka. OFRS also acts as the coordinating center for chemical analysis of samples for outside researchers.
- OFRS worked hand in hand with the SEDU throughout the year and contributed to science dissemination by participating in coordinating the Cyril Ponnamperuma Memorial International conference on Multidisciplinary Research 2020 and assisting in organizing the InnoTech 2020 - National Innovation and Technology Exhibition.

7.6 Progress of the Science Education & Dissemination Unit (SEDU)-2020

Objectives:
Foster the exchange of technical and scientific information for 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
- 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.

Main activity	Activity organized
Organize National and International conference and workshops with NIFS Scientists	Cyril Ponnamperuma Memorial International Conference on Multidisciplinary Research 2020 Date: 21.01.2020, Participation: 250 researchers
	NIFS Annual Research Review 2019(in situ & Online) Date: 30.07.2020, Participation: 150 researchers
	16th International Conference on Chemical Sciences was planned to held on the month of September This was postponed due to the prevailing Covid 19 crisis
	National Conference on Multidisciplinary Research (NCMR) 2020, Virtual Postgraduate Symposium-Jointly organized with Young Scientists' Association (YSA)/NIFS. This was a virtual conference Date: 08.10.2020, Participation: 126 researchers
Organize Seminars & special lectures	How Phone Microscopy and AI is Transforming Agriculture by Mr.Sivam Krish Date: 07.01.2020 Participation: 23 researchers Online webinar on "Imagines" Knowledge, responsibility and refashioning our identity By Dr. Vagisha Gunasekara, Senior Lecturer, Open University of Sri Lanka on 18.06.2020 Participation:41 researchers

Main activity	Activity organized
	How to write an effective abstract by Prof. M.C.M Iqbal 08.07.2020 Participation:64 researchers
Make aware the general public on the research conducted by NIFS	Inno Tech 2020 exhibition at Homagama, 11.03.2020-13.03.2020 Participation: 10,000 general public
	Introduced a new YouTube Discussion video series named "Research Talks" Produced and uploaded two
	Series of talks for one week was scheduled in Kadurata FM in parallel to World Science week and due to the covid 19 we had to cancel it.
	Series of short videos were produced in parallel to World Science week [2020-11-10 to 2020-11-17]
	Improved the NIFS Research Information Repository
	Increase the content of the NIFS website and publish research achievement and ongoing research projects on NIFS social media Accounts, Increase the blog articles on NIFS website
Inculcate scientific literacy among the school community	47th Annual School Science Programme was scheduled to be held in August. Due to the covid 19 pandemic this programme was cancelled
	Science short message service was conducted throughout the year. Wieners for the Q/A programme will be selected by the end of this month.

E-programs:

Programme	Performance in the year 2020	
	(Performance Indicators)	Number benefited
NIFS e-outreach *(Status: Ongoing)*		
Facebook page	Post Reached	389,917
Google My Business	Views on Google Maps & Search	171,120
LinkedIn	Post Reached	748
Twitter	Post Reached	16,488
Instagram	Post Reached	1,525
Web site	Page Views	126,938
YouTube	Views for videos	11,918
Science Message Service *(Status: Ongoing)*		
Blog	Page Views	8,420
Emails	Emails sent	125,224
Facebook Page	Post Reached	65,872
Twitter (Sinhala & English)	Post Reached	44,201
Website (Sinhala & English)	Page Views	25,123
Science YouTube Channel *(Status: Uploading currently on hold)*	Views for videos	196,341
Mobile Apps for Science Students *(Status: Uploading currently on hold)*		
Periodic Elements game App	Downloads	39
Sinhala Science Glossary App	Downloads	4,755
Sinhala Science Website *(Status: Currently On hold)*	Page Views	10,824
Total benefited		**1,199,453**

7.7 Progress of the Library - 2020

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

The library was engaged in the following services during the year

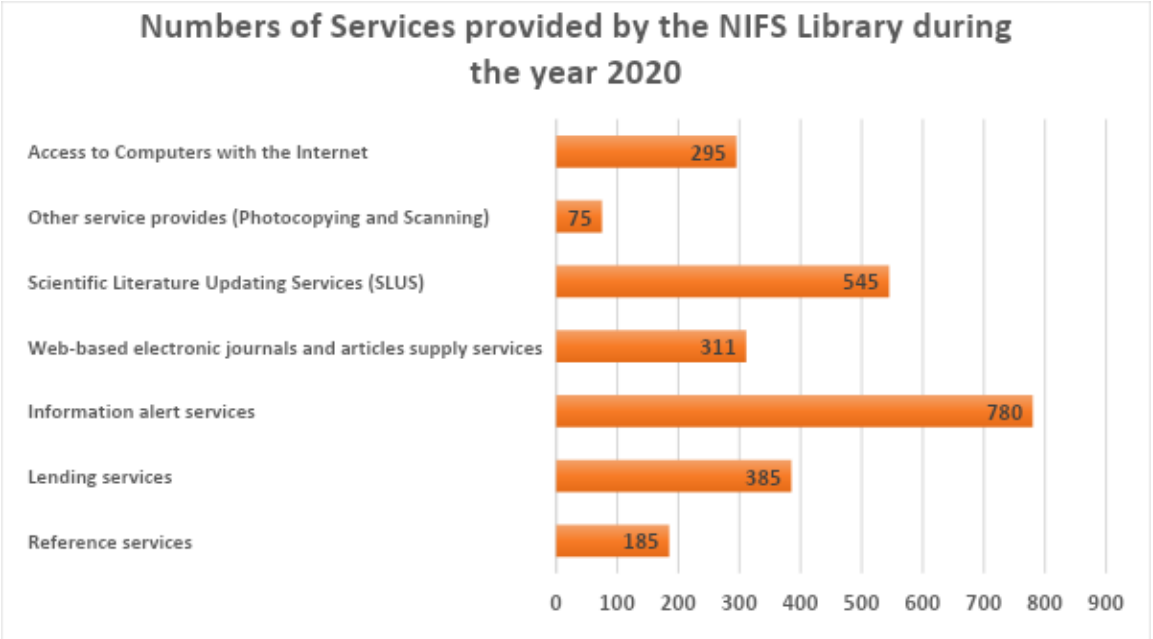
Provided reference and lending services, document delivery, resource sharing, inter-library loan facility, information alert services, new item arrivals alert service, sourcing web based electronic journals and articles, Scientific Literature Updating Service (SLUS), access to computers and internet, provision of 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. Kovoor, Prof. C. Ponnamperuma, Prof. C. Wickramasinghe, Prof. C.B. Dissanayake, Prof. K. Tennakone, and 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 online access to the research article collections of Prof. C. Wickramasinghe through the Center for Astrobiology in Sri Lanka.



7.8 Infrastructure Developments & Major instruments purchased

Due to the financial constraints no major infrastructure developments were made.

Following major instruments were purchased during 2020

- Reflex spectrometer system
- Multimode microplate reader

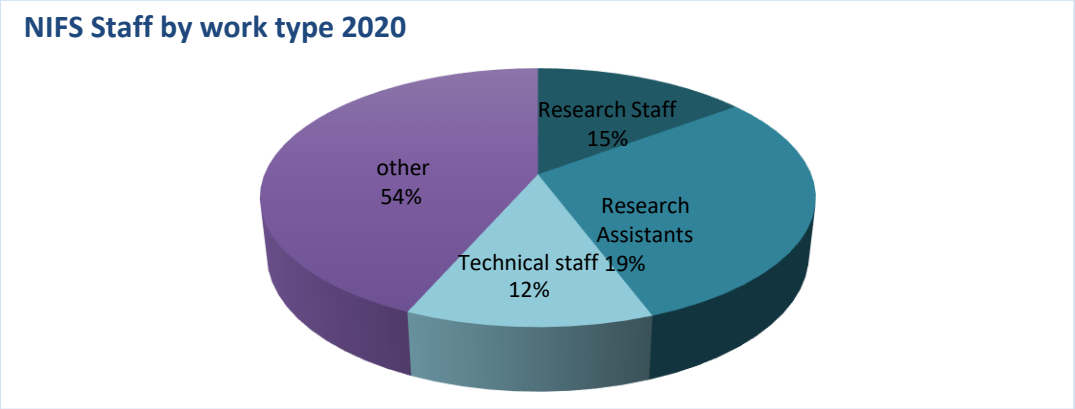
7.9 Welfare activities

Awareness programs on Corona by Dr. Mahen Kothalawala and oral cancer by Prof. Ruwan Jayasinghe were conducted for the NIFS staff. In addition, two plant sales were organized. Even though a lot of welfare activities were schedule they were cancelled due to the corvid pandemic.

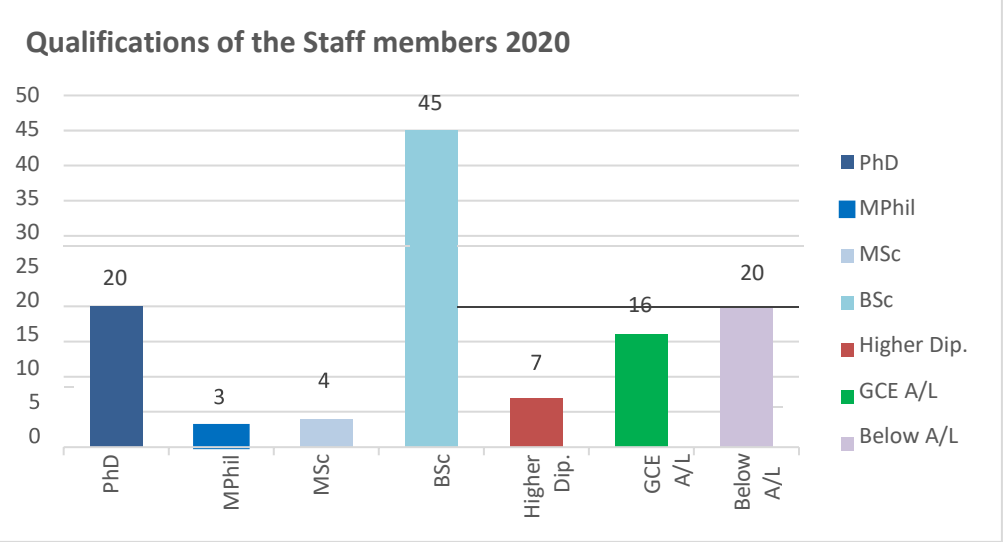
8. Human Resources

8.1 Summary of NIFS Staff

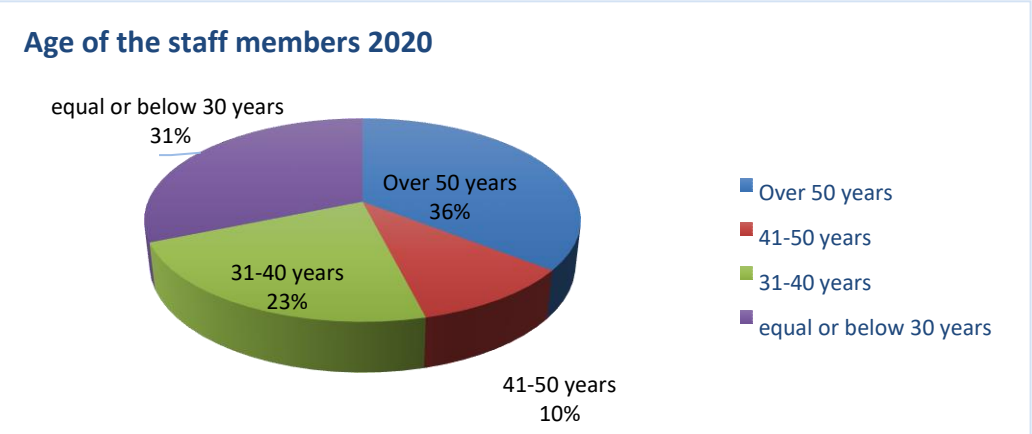
NIFS staff mainly comprises Research staff, Research supportive staff and Administration & Finance Staff. The following figure represents staff distribution based on the work type (as at 31/12/2020).



We have a well-qualified staff where over 50% are graduates. The following figure represents the staff distribution based on the qualification level (as at 31/12/2020).



In addition, we have an energetic staff. 64% of the staff is below 50 years of age. Hence the following figure shows the age distribution (as at 31/12/2020).



*8.2 NIFS Staff 2020 by service Level**

based on 2/2016 circular sub schedule III-as at 31/12/2020

Service Level*	Category		Number of employees
Senior Level	Research staff	Director	01 (contract basis)
		Senior Research Professors	03
		Research Professors	05 (contract basis-04)
		Associate Research Professors	05 (contract basis-01)
		Senior Research Fellows	02
		Research Fellows	01 (contract basis-01)
	Senior Managers	Secretary	01
		Coordinator/SEDU	01
	Middle Managers	Accountant	01
		Chief Technical Officers	11
		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(vacant)
		Internal Audit Officer	01(vacant)
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
		Driver Gr. III	02
		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

8.3 Staff Recruitments & end of service

8.3.A. Staff recruitment 2020

Research Assistants (Gr.II)

Ms. A.MA.M. Abeysinghe
Ms. R.A.L.R. Amarasena Ms.
P.M.C.J. Bandara
Ms. W.R.U.A. Bandara Mr.
W.T.R.S. Fernando Ms.
M.S.H. Hettiarachchi Ms.
J.C. Kalinga
Ms. H.M.H.D.K. Naranpanawa Ms.
T.M. Paranavithana
Ms. M.D.R. Perera
Ms. T.M.U.E.K. Samarakoon
Ms. D.G.S.N.Samarasinghe Ms.
K.D.P.U. Siriwardhane

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8.3.B. End of service 2020

Senior Research Professor

Prof. Asiri Nanayakkara (Resigned)

Research Assistants

Ms. S.M.N.K. Thilakarathne (Resigned) Ms.
S.T. Kaushalya (Resigned)
Ms. D.M.D.M. Dissanayake (Resigned) Mr.
H.M.D.A.H. Bandara (End of contract)
Dr. D.M.R.E.A. Dissanayake (End of contract) Ms.
F.A. Deen (End of contract)
Ms. S.S.K. Marasinghe (End of contract) Mr.
K.M. De. Silva Subaseela (Resigned)

Chief Technical Officer

Mr. Sanath Opatha (Retired)

Internal Audit Officer

Mr. W.M.I.U.B. Wijesinghe (Resigned)

8.4 Capacity Building / Skill Development Programs

Name	Name of the Training Program	Institute / Training Provider	Funding Agency/ Institute	Time period
Ms. D.D.M.O. Dissanayake	National Workshop on Short Course on (Advance course) GIS and Applications	Department of Geology, University of Peradeniya		Six days
Ms. J.M.K.W. Kumari	International Training Programme on Introductory Training Course in Nanofabrication Technologies	Indian Institute of Sciences, Bangalore, India	Ministry of External Affairs, Government of India	Twenty days
Ms. J.M.K.W. Kumari	Training workshop on AFM and XRD	Faculty of Science, University of Jaffna	Norwegian Partnership Programme for Global Academic Cooperation (NORPART)	Two days
Ms. T.M. Paranavithana	National Workshop on Short Course on (Advance course) GIS and Applications	Department of Geology, University of Peradeniya		Six days
Dr. S. Rajakaruna	Patent searching and prior art assessment for IP- based innovation in the framework of enabling innovation environment for intellectual property and technology	World Intellectual Property Organization (WIPO), National Intellectual Property Office Sri Lanka (NIPO), Coordinating Secretariat for Science Technology and Innovation (COSTI), and Ministry of Higher Education, Technology & Innovation Sri Lanka	N/A	Three days
Dr. S. Rajakaruna	Patent Drafting	WIPO, NIPO, (COSTI), and Ministry of Higher Education, Technology & Innovation Sri Lanka	N/A	Eleven days
Ms. W.I. Sandamali	Training workshop on AFM and XRD	Faculty of Science, University of Jaffna	Norwegian Partnership Programme for Global Academic Cooperation (NORPART)	Two days
Mr. M. Senevirathne	IAM Workshop February 2020	Lanka Education and Research Network (LEARN)	Lanka Education and Research Network (LEAR N)	Five Days
Prof. G.K.R. Senadeera	International Training Programme on Introductory Training Course in Nanofabrication Technologies	Indian Institute of Sciences, Bangalore, India	Ministry of External Affairs, Government of India	Twen ty days

Name	Name of the Training Program	Institute / Training Provider	Funding Agency/ Institute	Time period
Ms. S.M.N.K. Thilakarathne (NIFS RA)	International Workshop on Hands on training in Computational Biology for (Meta) Genomics Analysis	Microbial Ecology Network Nepal	Microbial Ecology Network Nepal	One day
Mr. K. Umair	Training workshop on AFM and XRD	Faculty of Science, University of Jaffna	Norwegian Partnership Programme for Global Academic Cooperation (NORPART)	Two days

Awards:

Several awards were presented to academic and non-academic staff of NIFS appreciating their performance and contribution towards research and the institute. The following staff members were presented with awards for their contributions in year 2019, and they were given the awards in 2020.

Most Outstanding Researchers

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

Research Publication Excellence

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

Outstanding Work Performance Awards

- Mr. Gamage Ariyarathne
- Mr. Viraj Ekanayake
- Mr. D. G. Gunathilaka
- Mr. Supun Kuruppuarachchi
- Mr. Chanaka Lekamge
- Mr. Anura Pathirana
- Mr. Ranjith Peiris
- Ms. Chandani Ranasinghe
- Mrs. Sujeewa Sakalasooriya
- Mr. Somananda Molagoda
- Mrs. Chandrika Tilakaratne

Service Award

- Mr. Mahesh Kulatunga

9. AUDITED FINANCIAL STATEMENT 2020

9.1 Summary of Financial Results

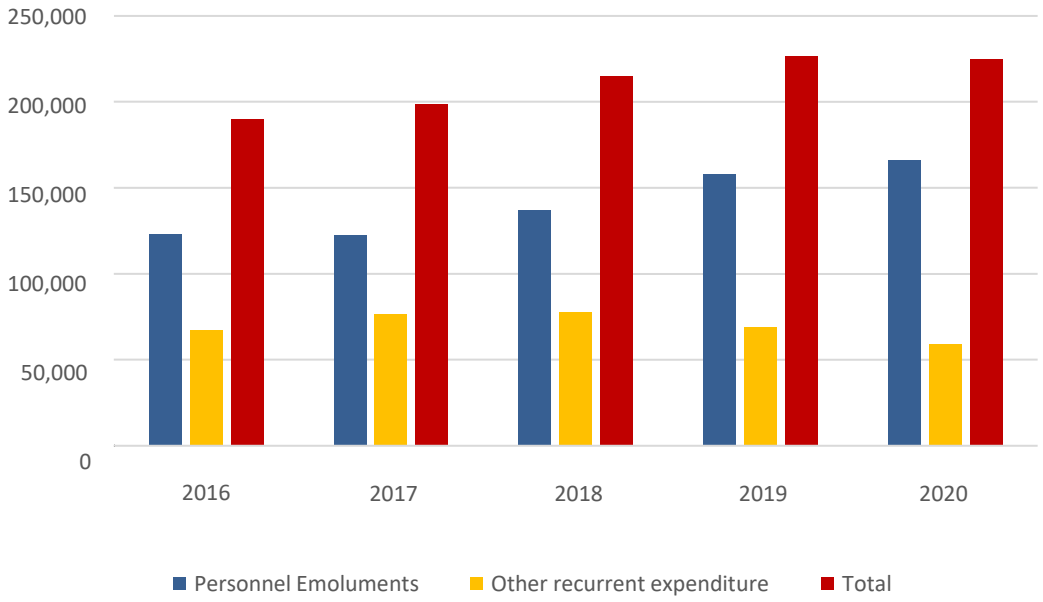
9.1.1 Comparison of Expenditure with previous years

9.1.1.1 Recurrent Expenditure comparison- five years

Rs.'000

	2016 (*)	2017(*)	2018(*)	2019(*)	2020
Personnel Emoluments	122,808	122,430	137,186	157,735	165,931
Other recurrent expenditure	67,293	76,188	77,800	68,817	58,981
Total	**190,101**	**198,618**	**214,986**	**226,552**	**224,912**

(*) Re-stated Figures)



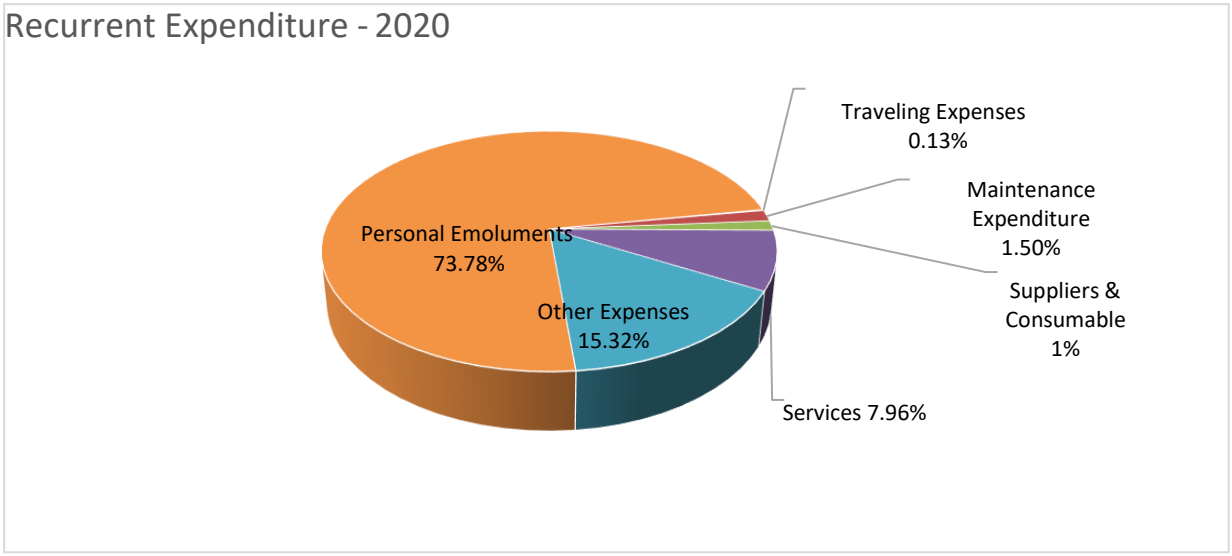
9.1.2. Capital Expenditure comparison- five years

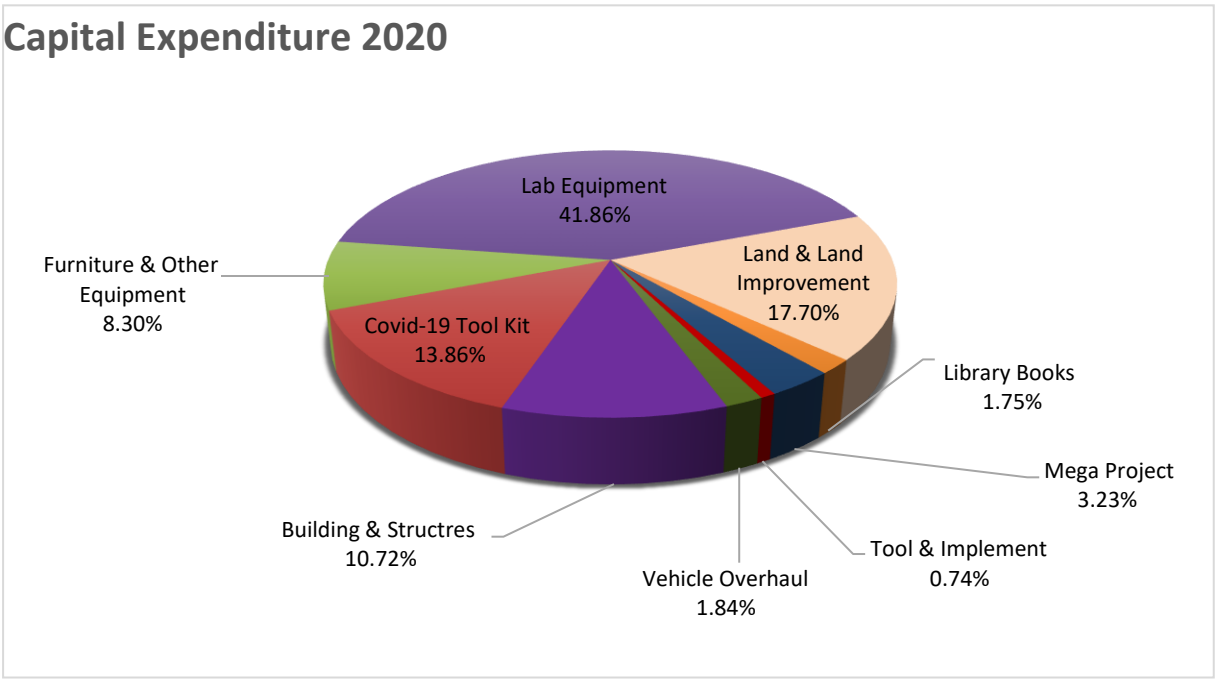
Rs.'000

Year	2016	2017	2018	2019	2020
Acquisition of fixed assets	110,302	99,355	57,931	62,802	15,160
Building Construction	19,741	17,193	19,561	19.036	2,252
Research & Development	-	-	15,458	3,135	3,589
Total	130,043	116,548	92,950	84,973	21,001

9.2 Summary of financial results for the year ending 31.12.2020

	Recurrent Amount (Rs. '000)	%	Capital Amount (Rs. '000)	%
2019				
Budgeted	338,993	100	546,250	100
Approved	201,171	59.34	81,000	14.83
Released	201,171	59.34	48,300	8.84
2020				
Budgeted	330,434	100	166,950	100
Approved	210,000	63.55	38,000	22.76
Released	208,860	63.21	358,000	22.76





9.3 Statement of financial position

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES SRI LANKA

STATEMENT OF FINANCIAL POSITION AS AT 31.12.2021

	NOTE	SLRs 2020	(RESTATED) SLRs 2019
ASSETS			
CURRENT ASSETS			
CASH AND BANK BALANCES	1	134,640,275.52	108,990,251
DEPOSITS PREPAYMENTS & ADVANCES	2	6,061,626.52	27,608,258
DISPOSAL OF FIXED ASSETS		59,669.77	59,670
FESTIVAL ADVANCE FUND INVESTMENT		300,000.00	300,000
CONSUMPTION LOAN FUND INVESTMENT		300,000.00	300,000
INTEREST RECEIVABLE FOR FIXED DEPOSITS		7,351,565.87	7,814,724
STAFF CONSUMPTION LOAN	3	4,954,731.00	5,015,609
ADVANCE AND OTHER RECEIVABLE	4	128,380.48	210,677
STOCKS	5	1,444,710.66	1,800,760
		155,497,876.42	**152,103,430**
NON-CURRENT ASSETS			
WORK IN PROGRESS	6	-	5,567,761
PRELIMINARY EXPENSES FOR CONSTRUCTION		332,319.49	332,319
PROVIDENT FUND INVESTMENT	7	122,736,536.35	111,505,089
TRAINING CAPACITY		949,197.40	949,197
MEGA PROJECT- RECHARGEABLE BATTERIES		2,145,541.75	2,116,426
COVID 19 -TOOL KIT			2,437,892.39
PROPERTY, PLANT AND EQUIPMENT	8	543,185,623.21	593,417,742
		702,326,876.16	**725,119,982**
TOTAL ASSTES		**857,824,752.58**	**877,223,412**
LIABILITIES			
CURRENT LIABILITIES			
ACCOUNTS PAYABLE	9	3,190,575.65	8,487,334
ACCRUED EXPENSES	10	2,495,172.63	3,013,819
		5,685,748.28	**11,501,153**
NON CURRENT LIABILITIES			
SPECIFIED FUNDS & GRANTS	11	183,399,212.21	156,978,269
DEFERRED LIABILITIES	12	214,164,154.86	188,156,515
		397,563,367.07	**345,134,784**
TOTAL LIABILITIES		**403,249,115.35**	**356,635,937**
NET ASSETS		**454,575,637.23**	**520,587,475**
NET ASSETS/EQUITY			
CAPITAL FUND - SPENT	13	655,584,259.32	670,608,790
- UNSPENT		80,864,119.90	63,862,681
PRESIDENT'S FUND - SPENT		7,078,501.15	7,078,501
ASSET REVALUATION RESERVE		118,388,385.47	118,388,385
INSTITUTE FUND		(407,339,628.61)	(339,350,882)
TOTAL NET ASSETS/EQUITY		**454,575,637.23**	**520,587,475**

The Accounting polices 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 31.12.2020

	NOTE	SLRs 2020	(RESTATED) SLRs 2019
OPERATING REVENUE			
RECURRENT GRANT		208,860,000.00	201,171,000.00
OTHER INCOME	14	47,031,634.85	38,746,510
EXPENDITURE		**255,891,634.85**	**239,917,510**
PERSONAL EMOLUMENTS	15	165,931,396.34	157,735,317
TRAVELLING	16	303,397.50	437,163
SUPPLIERS & CONSUMABLE	17	2,940,819.58	6,798,876
MAINTENANCE	18	3,369,758.27	5,483,217
CONTRACTUAL SERVICES	19	17,905,251.54	20,828,840
DEPRECIATION		96,327,000.04	92,577,937
OTHER EXPENSES	20	34,461,673.50	35,269,213
TOTAL OPERATING EXPENSES		**321,239,296.77**	**319,130,563**
DEFICIT FROM OPERATING ACTIVITIES		(65,347,661.92)	(79,213,053)
FINANCE COST			
PROFIT/(LOSS) OF FIXED ASSETS		54,216.65	(200,050.00)
NET DEFICIT FOR THE YEAR		**(65,293,445.27)**	**(79,413,103)**

9.5 Statement of cash flow

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES SRI LANKA

STATEMENT OF CASH FLOW FOR THE YEAR ENDED 31.12.2020

	REFERENCE	SLRs. 2020		(RESTATED) SLRs. 2019
Cash-Flow from Operating Activities				
Deficit for ordinary activities	Page 5	(65,293,445		(79,413,103)
			(65,293,445)	**(79,413,103)**
Non Cash Movements				
Depreciation	Page 19 - Note 8	96,327,000		92,577,937
Amortization of the Deferred Liability	Page 27 - Note 14	(22,170,566)		(15,732,587)
Profit on Disposal of Capital Assets	Page 5	(54,217)		200,050
Provision for Gratuity	Page 30 - Note 20	6,951,566		6,932,429
(Increase)/Decrease Staff Consumption Loan	Page 4 - Note 3	60,878		(209,662)
(Increase)/Decrease Stocks	Page 4 - Note 5	356,049		497,579
(Increase)/Decrease Advance and other Receivable	Page 4 - Note 4	82,297		31,070
(Increase)/Decrease Deposits, prepayment and Advances	Page 11 - Note 2	21,546,631		(13,586,223)
Increase/(Decrease) Accounts Payable	Page 4 - Note 9	(5,296,759)		(494,111)
Increase/(Decrease) Accrued Expenses	Page 4 - Note 10	(518,646)		(337,627)
Gratuity Paid		(2,090,128)		(3,136,442)
Foreign Currency Exchange Gain		(643,173)		
Donations of Consumable items		6,686		
Movement of Fund Account		2,747,685		(1,157,320)
Increase/(Decrease) Differed Liability				6,743,332
			97,305,303	
Net Cash flow from Operating Activities			**32,011,858**	**(7,084,678)**
Cash Flow from Investing Activities				
(Increase)/Decrease Working in progress	Page 4 - Note 6	5,567,761		11,887,279
Purchase of Property Plant & Equipment	Page 19-Note 8	(43,551,841)		(87,805,084)
Sale of Property Plant & Equipment		54,217		
(Increase)/Decrease Int.rec.for Fixed Deposits	Page 4	463,158		(570,702)
Construction	Page 4	-		378,988
Investments made- Provident Fund	Page 4 - Note 7	(30,539,765)		(11,231,447)
- Consumption Loan Fund	Page 4	(253,436)		(7,156)
-Mega Project	Page 4	(29,116)		(1,177,346)
-Covid 19-Tool Kit	Page 4	(2,437,892)		
Net Cash Flow from Investing Activities			**(70,726,913)**	**(88,525,468)**
Cash Flows from Financing Activities				
Government Capital Contribution	Page 6	38,000,000		48,300,000
Specific Funds and Grants	Page 4 - Note 11	26,365,080		5,770,941
			64,365,080	**54,070,941**
Net Cash Flow from Financing Activities				
Net increase/ (Decrease) in cash and cash equivalent			25,650,025	(41,539,205)
Cash and cash equivalent at beginning of period	Page 11 - Note 1		**108,990,251**	**150,529,456**
Cash and cash equivalent at the end of the period	Page 11 - Note 1		**134,640,276**	**108,990,251**

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 31.12.2020

ATTRIBUTABLE TO OWNERS OF THE CONTROLLING ENTITY					
	CONTRIBUTED CAPITAL	**PRESIDENT FUND**	**REVALUVATION SURPLUS**	**INSTITUTE FUND**	**TOTAL NET ASSEST/EQUITY**
BALANCEAS AT 31 DECEMBER 2020	734,471,470.86	7,078,501.15	118,388,385.47	(339,045,377.34)	520,892,980.14
PRIOR YEAR ADJUSTMENT	-	-	-	(305,504.48)	(305,504.48)
BALANCEAS AT 31 DECEMBER 2020 (RESTATED)	734,471,470.86	7,078,501.15	118,388,385.47	(339,350,881.82)	520,587,475.66
ADDITION DURING THE YEAR TO INSTITUTE FUND	-	-	-	(2,695,301.52)	(2,695,301.52)
DEFICIT FROM OPERATING ACTIVITIES	-	-	-	(65,347,661.92)	(65,347,661.92)
DESPOSAL OF FIXED ASSETS	-	-	-	54,216.65	54,216.65
CAPITAL FUNDS RECEIVED FROM GOVERNMENT & OTHER SOURCES	38,000,000.00	-	-	-	38,000,000.00
TRANSFER TO DEFERRED LIABILITY	(36,023,091.64)	-	-	-	(36,023,091.64)
BALANCE AS AT 31 DECEMBER 2020	**736,448,379.22**	**7,078,501.15**	**118,388,385.47**	**(407,339,628.61)**	**454,575,637.23**

9.7 Accounting policies year 2020

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES - SRI LANKA

SIGNIFICANT ACCOUNTING POLICIES YEAR ENDED 31ST DECEMBER 2020

(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 are 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 fully at the time of disposal 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 Structures

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 acquired from the government grant, outside grants and the received as Donations, have been recognized as Deferred Liability from the year 2018 and recognized as Amortization income, which calculating according to the rates provided by specified in 2.2.6.

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%
Office & Miscellaneous	
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 are 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 N.I.F.S. PROVIDENT FUND

Members' fund as at 31st December 2020 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

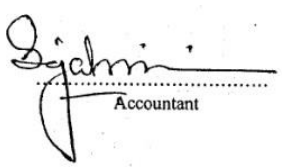
All foreign and other monetary grants received during the year, are dealt with by charging to the Statement of Financial Performance to the extent of such grants recognized in the Financial Statements do match with the associated costs incurred during the year. Unspent grants during the year are shown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



10. REPORT OF THE AUDITOR GENERAL ON THE FINANCIAL STATMENT

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

My No. CLG/KD/J/N/IFS/2021/11 Date: 13th May 2021

Director,
National Institute of Fundamental Studies.

Auditor General's Report in terms of Section 12 of the National Audit Act No. 19 of 2018 on Financial Statements and Other Legal and Regulatory Requirements of the National Institute of Fundamental Studies for the Year Ended as at 31st December 2020

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Certified account and the above report are forwarded herewith.

W.P.C. Wickramaratne
Auditor General

Copies :- 01. Secretary – Ministry of Finance
02. Secretary – State Ministry of Skills Development, Vocational Education, Research and Innovations

My No. CLG/KD/J/NIFS/2021/11 Date: 13th May 2021

Director,
National Institute of Fundamental Studies.

Auditor General's Report in terms of Section 12 of the National Audit Act No. 19 of 2018 on Financial Statements and Other Legal and Regulatory Requirements of the National Institute of Fundamental Studies for the Year Ended as at 31st December 2020

……

1. Financial Statements

1.1 Qualified Opinion

The audit of the financial statements of the National Institute of Fundamental Studies for the year ended as at 31st December 2020 comprising the statement of financial position as at 31st December 2020 and the statement of financial performance, statement of changes in equity and cash flow statement for the year then ended, and notes to the financial statements, including a summary of significant accounting policies, was carried out under my direction in pursuance of provisions in 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 and the Finance Act No. 38 of 1971. In accordance with Article 154 (4) of the Constitution, my report will be tabled in Parliament in due course.

In my opinion, except for the effects of the matters described in the basis for qualified opinion section of this report, the financial statements give a true and fair view of the financial position of the Institute as at 31st December 2020, and of its financial performance and cash flows for the year then ended in accordance with Sri Lanka Public Sector Accounting Standards.

Indications, if any, will be included in the report tabled by me in Parliament in due course in terms of Article 154 (6) of the Constitution.

1.4 Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Sri Lanka Public Sector Accounting Standards and for such internal control as the management determines is necessary to enable the preparation of financial statements that are free from material misstatements, whether due to fraud or error.

In preparing the financial statements, 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 intend to liquidate the Institute or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Institute's financial reporting process.

As per Sub – section 16 (i) 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 of the Institute.

1.5 Auditor's Responsibility for Auditing 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.

As part of an audit in accordance with Sri Lanka Auditing Standards, I exercise professional judgement and maintain professional skepticism throughout the audit. I further:

- Appropriate audit procedures were designed and performed to identify and assess the risks of material misstatement in financial statements whether due to fraud or errors in providing a basis for the expressed audit 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.

- An understanding of internal control relevant to the audit was obtained in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the management.

- Conclude on the appropriateness of the management's use of the going concern basis of accounting and based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Institute's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. However, future events or conditions may cause the Institute to cease to continue as a going concern.

- 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 those charged with governance regarding, among other matters, significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

2. Report on Other Legal and Regulatory Requirements

2.1 The National Audit Act No. 19 of 2018 includes special provisions regarding the following requirements.

2.1.1 In accordance with the requirements of Section 12(a) of the National Audit Act No. 19 of 2018, I obtained all the information and explanations required for the audit, and proper financial records have been maintained by the Institute, according to my investigation.

2.1.2 According to the requirement of Section 6(1)(d)(iii) of the National Audit Act No. 19 of 2018, the financial statements of the institution correspond with the previous year.

2.1.3 In accordance with the requirement of Section 6(1)(d)(iv) of the National Audit Act No. 19 of 2018, the recommendations made by me last year are included in the presented financial statements.

2.2 On the basis of the proceedings followed and the evidence obtained and confined to the material facts, nothing has come to my notice to the extent of making the following statements.

2.2.1 According to the requirement of Section 12 (d) of the National Audit Act No. 19 of 2018, any member of the governing body of the institution has a relationship, directly or otherwise, out of the ordinary course of business in relation to any matter related to the institution.

2.2.2 In accordance with the requirement mentioned in Section 12 (E) of the National Audit Act No. 19 of 2018, that they have acted in a manner that does not comply with any relevant written law or other general or special directives issued by the governing body of the institution.

2.2.3 According to the requirement mentioned in Section 12 (h) of the National Audit Act No. 19 of 2018, the resources of the institution have not been procured and used in accordance with the relevant laws and regulations within the periods in a frugal, efficient and effective manner.

2.3 Other facts

(a) Even though it has been stated that vacancies should be filled in a short period of time in when managing the staff in accordance with Section 9.10 in Circular No. PED/12 and dated 02nd June 2003 of the Director General of Public Enterprises, there were 27 vacancies in 09 positions in the staff of the National Institute of Fundamental Studies as at 31st December 2020. Since 17 officers were the research staff, it was difficult to achieve the basic objectives of the National Institute of Fundamental Studies established for research work.

(b) Even though the land in extent of 14 acres, 02 roods 17.5 perches that belonged to the Hanthana Estate has been transferred to the National Institute of Fundamental Studies by a letter dated 08th January 1990 of the National Estate Development Board, no action has been taken to obtain the legal title of it even by the end of the year under review.

(c) 05 research project proposals with an estimated value of 566.6 million rupees proposed to be implemented in the years 2018 – 2020 have not been implemented as approval of the Ministry of Science, Technology and Research had not been received.

(d) Even though an agreement has been entered into on 28th March 2016 with a private institution to establish an Integrated Software System for the National Institute of Fundamental Studies, again an agreement has been entered into with the same private institution on 26th March 2018 as the relevant system had not been installed. Though institution has spent an amount of Rs.660,000 as advance payment and Rs. 6,864,960 to purchase computers and accessories, the system had not been installed even by the end of the year under review.

(e) When compared the actual expenditure with the budgeted expenditure of the year under review, there was an increase from 88 percent to 1158 percent in 02 object codes, and a decrease from 26 percent to 98 percent in 11 object codes while an expenditure of Rs. 22,848,617 had been incurred for 05 object codes without preparing budget estimates.

W.P.C. Wickramaratne
Auditor General

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

(This is a translation. Please refer the repot in Sinhala for the original) **Observations of the Board of Governors on 30th December 2021 with regard to the Report of the Auditor General issued on 5th October 2021 on the Financial Statements and other Affairs of the National Institute for Fundamental Studies for the year ended on 31.12.2020 in terms of Section 13(7)(a) of the Finance Act No. 38 of 1971.**

1.4 Financial Publications

1.4.1 Non-compliance with Sri Lanka Public Sector Accounting Standards

(A) I accept. Steps have been taken to revise the Accounting Procedure 03 accordingly.

(B) Accept. Disclosure will be made in accordance with the Accounting Standard.

1.4.2 **Accounting Principles**

Audit observations

I accept. Steps have been taken to revise the Accounting Code 03 in a systematic manner.

1.4.3 **Accounting Principles**

Audit observations

(A) I accept. Steps have been taken to revise the Accounting Procedure 03 accordingly.

(B) Prepared for public auction in the near future.

(C) I accept. Steps are being taken to make corrections.

(D) I accept. Steps will be taken to comply with the Accounting Principles.

(E) I accept. Relevant corrections will be made.

(F) I accept. Refunded deposits will be followed up after mailing.

1.5 Non-compliance with rules and regulations

(A) Acts

I accept. Necessary steps have been taken to expedite the preparation of annual reports.

(B) Financial Regulations of the Socialist Republic of Sri Lanka

i. Financial Regulation 756

I accept. Steps have been taken to conduct annual board of surveys properly.

ii. Financial Regulation 751 (1)

I accept. Wholesale bookkeeping has begun.

iii. Financial Regulation 757 (2)

I accept. Steps have been taken to expedite the survey of goods.

iv. Financial Regulation 756 (2)

I accept. Steps have been taken to conduct inventory surveys in accordance with Financial Regulations.

v. Financial Regulation 770

I accept. Items identified by inventory survey reports will be dealt with in a circular manner.

(C) Circulars

I accept. Preparation of a fixed asset register has begun.

(D) 2006 Government Procurement Guidelines Code

2.8.4 Guidelines

I accept. Follow the guidelines.

3 Non-compliance with rules and regulations

3.1 **Management inefficiencies**

Audit observations

(A) I accept. Fees are to be revised after obtaining the necessary instructions.

(B) I accept. Relevant steps are being taken.

(C) I accept. Relevant steps are being taken.

(D) I accept. Working to fill the essential vacancies.

(E) I accept. Working to fill the essential vacancies.

3.2 Operational Inefficiencies

Audit observations

(A) I accept. Preparation of a fixed asset register has begun.

(B) I accept. Relevant steps will be taken to maintain fixed deposits more effectively.

(C) I accept. Will do the choreography with approval.

(D) Rs. 592.6 million which was proposed to be activated for the year 2018-2020 JK "Developing Biofilm Bio Fertilizer Based Natural Fertilizer to cut down further Chemical Fertilizers in Agriculture and Plantation" project, funded by the Ministry of Science, Technology and Research out of 06 estimated research projects, will be operational by 2021.

(E) I accept. Steps have been taken to expedite the process of obtaining patents.

(F) I accept. Necessary steps are being taken to revise the room rates.

(G) I accept. Agreements with the computer software system will be generously acted upon.

(D) I accept. Steps will be taken to invest the existing funds in the account wisely.

3.3 Human Resource Management

Audit observations

(A) I accept. Working to fill the essential vacancies.

(B) I accept. Working to fill the essential vacancies.

(C) I accept. Obtaining approval to fill the relevant posts will be expedited.

4. Accountability and good governance

4.1 Cooperate plan

Audit observations

I accept. Steps have been taken to prepare, update and submit the integrated plan in accordance with the circulars.

4.2 Internal Audit

Audit observations

I accept. Steps have been taken to appoint an Internal Auditor.

4.3 Budget Control

Audit observations

(A) I accept. To use the budget as a control tool
Steps have been taken.
(B) I accept. In the future estimates will be prepared to include all expenditure subjects.

ANNUAL REPORT 2020

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