NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

ANNUAL REPORT
2015

MINISTRY OF TECHNOLOGEY AND RESEARCH

Institute of fundamental Studies
Hantana Road
Kandy

Tel : 081-2232002
Fax : 081-2232131
Email : ifs@ac.lk

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Introduction: National Institute of Fundamental studies (NIFS)

The National I:nstitute of Fundamental Studies (NIFS) was established by an Act of Parliament in 1981, to promote and conduct fundamental research in the physical sciences, life sciences, social sciences and philosophy. Fundamental research was first conceived by the former president of Sri Lanka, H.E. J. R. Jayawardane in 1979. He invited Prof. Chandra Wickremasinghe from the Cardiff University in the UK, to establish the Institute of Fundamental Studies (IFS).

The aims and objectives of the Institute (as stated in the Act No. 55 of 1981, Part 1 as amended by Act No.5 of 1997, section 3 and Act No 25 of 2014) are to create an interest in and to provide facilities for fundamental and advanced studies and in particular to:

a. initiate, promote and conduct research and original investigations to fundamental studies in general with particular emphasis on mathematics, physical and chemical sciences, life sciences, social sciences and philosophy, taken in the broadest sense;

a.a. to collaborate with public and private institutions as may be necessary to develop applications relevant to the studies conducted in relation to paragraph(a)

b. arrange lectures, meetings, seminars and symposia in pursuance of its research work and for the diffusion of scientific knowledge;

c. invite scientists in Sri Lanka and from abroad, who are actively engaged in creative work to deliver lectures and participate in its research activities;

d. establish and maintain liaison with scientific workers and scientific institutions in other countries and promote international co-operation in matters relating to the aims and objects of the Institute, while taking care to protect and promote the ntional interest;

e. provide training, guidance and assistance for research leading to the award of post graduate degrees by institutions recognized by the University Grant commission established by the University Act, No.16 of 1978."

f. do such other acts and things as may be necessary to promote the aims and objectives of the Institute.

The NIFS began work in 1981, in a two roomed building at the present Colombo office of the IFS. In 1984, Prof. Cyril Ponnamperuma was appointed as the director of the NIFS. The government acquired the Hantana Hotel in Kandy and the hotel rooms were transformed to research laboratories. Advanced research equipment was made available through an outright JICA grant from Japanese Government to the value of US $ 5.7 million. Prof. C.B. Dissanayake succeeded Prof. Ponnamperuma as director in 1991 and carried forward the research activities until 1994. Prof. K. Tennakone was the director from 1994-2008. And Prof. C.B.Dissanayake was re appointed as the director in 2009. Present Director Prof B.H.P.P. Karunarthna appointed in 01.10.2015.

The year 2014 saw the Institute achieving national status with a change of the name to National Institute of Fundamental Studies. With this change and the amendment to the Act, passed by the Parliament, the National Institute of Fundamental Studies now has a new Governing Board comprising mostly of senior academics in the university system. In view of the strong links which we now have with the universities in Sri Lanka, this augurs very well for the future. As a leading research institute in the country, the output of our research activities have been very encouraging and indeed the increasing interest shown by the private sector on our fundamental research findings have borne fruit. With the amendment to the Act empowering the National Institute of Fundamental Studies to work with the private sector, if useful applications arise from the our fundamental research, a large gap that had existed between the academia and the commercial sector is beginning to be bridged. The Consultative and Collaborative Division (CCD) has once again performed creditably. It is expected that this trend will gather even greater momentum in the following year. The Science Dissemination and Education Unit (SEDU) has continued its excellent progress and is now one of Sri Lanka's leading science dissemination units. The many awards that they received during 2014 bear ample evidence to their outstanding achievements. The research on biochar proved to be yet another major achievement of the Institute. The leader of the project Dr. Meththika achieved the top 3rd place in biochar research publications in SCI indexed journals in the world. This is indeed a most laudable achievement for a scientist from Sri Lanka working with very limited resources. The near completion of the new four storied building will almost certainly provide a major boost to the institute with new projects planned for the forthcoming year. The training of postgraduate students will also see a marked increase in 2015. The dedication and team effort of our scientists, technical staff, administrative officers and others have contributed in no small way towards achieving our targets.

INSTITUTE VISION AND MISSION

VISION

To be a renowned centre of excellence for research in fundamental studies

MISSION

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

Board of Governors

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Dean, Faculty of Science, University of Peradeniya

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National Institute of Fundamental Studies

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Dr. H.W.M.A.C. Wijayasinghe
National Institute of Fundamental Studies

Mr. P.S.B. Wanduragala - Secretary to the
Research Council
National Institute of Fundamental Studies

S.H.P.P.karunartne

Director
Natioal Institute of Fundamental Studies
+94 812232001
dirifs@yhoo.com

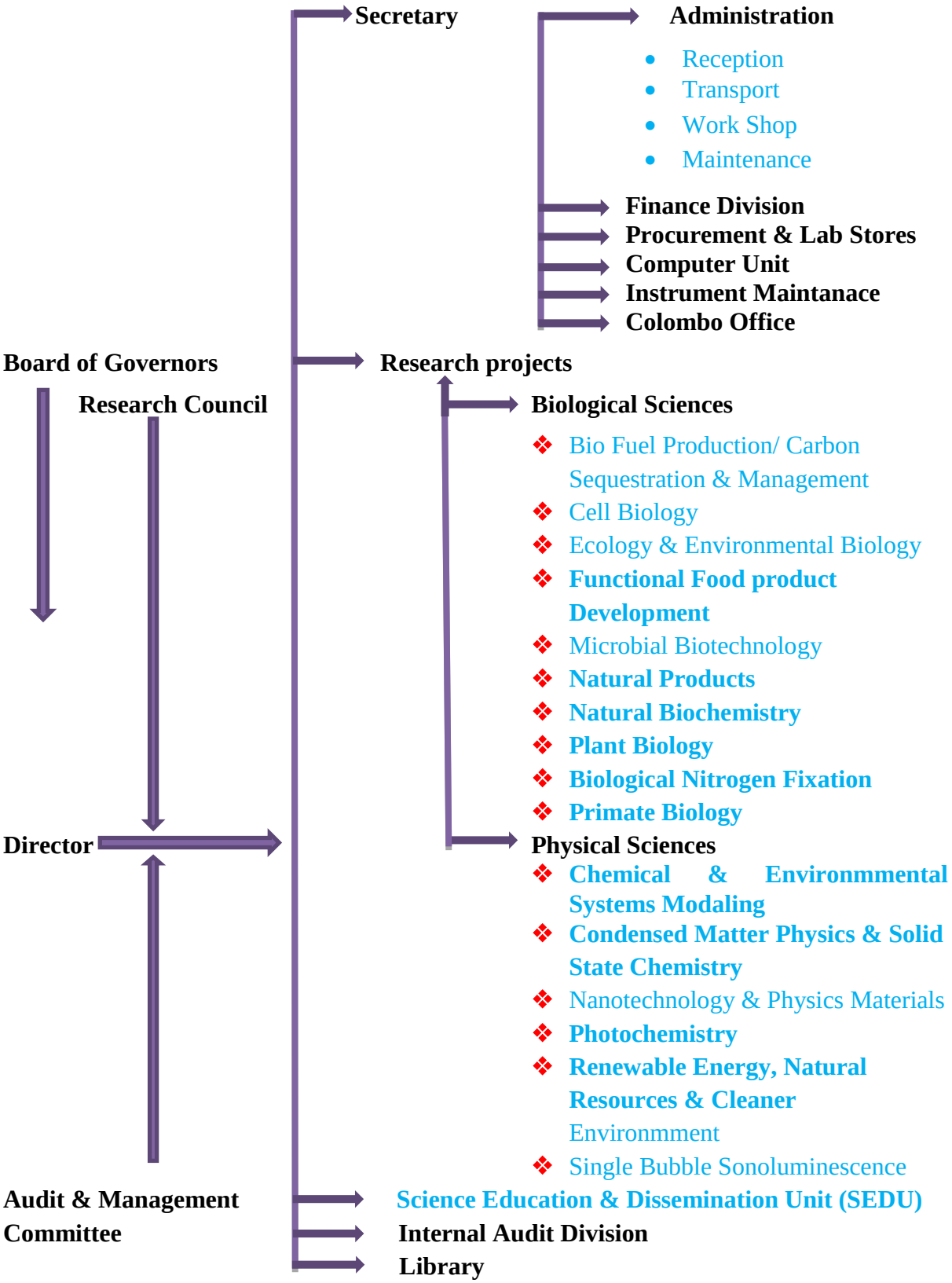
Message from the Director

As the present Director of the Institute, I have a great pleasure in making this note on the occasion of the 2015 Annual Report. The Institute of Fundamental Studies was established in September, 1981 by the Parliament Act No. 55 and shifted its location from Colombo to Kandy on 04th December 1985. The name of the institute was changed to National Institute of Fundamental Studies (NIFS) Sri Lanka by the Act No. 25 of 2014. NIFS is the only national institute, which, by its Act, has the main objective as to, engages in scientific research to facilitate fundamental and advanced studies with an emphasis on basic research for national development as well as for the advancement of science.

Over the years, NIFS has achieved several goals with the limited number of senior scientists it has. Progress achieved during the year 2015 under review has been excellent and the research carried out at NIFS has made a significant contribution towards science, in general, and the development of the country. Basic research leading to useful applications in numerous scientific fields, especially in the development of low- cost environmental friendly biofilm bio fertilizer, novel methodologies for environmental remediation, new diagnostic techniques for pulmonary diseases, novel technologically important materials for solar energy conversion, nano-water filters for water purification, and bio char research on environmental remediation has made excellent progress. The research scientists have published their findings in reputed international journals and the Institute has gained a wide recognition as a leading research center. Sixty two research papers in referred journals including 60 in SCI/SCI expanded journals, 05 book chapters and 109 conference papers/ abstracts have been published in the year 2015 along with two patents (one International and one National). At present there are 16 senior scientists, and 81 research students (12PhD, 69 MPhil candidates) are carrying out postgraduate research work under their supervision. In the year 2015, 09 research assistants obtained their postgraduate degrees (02 Ph.Ds. and 07 M.Phils.). In addition, several M.Sc. students and undergraduates from different parts of the island completed their research projects at NIFS. Science Education

and Dissemination Unit (SEDU) has concluded another excellent year and many school children and teachers, and the general public have benefited the inspiring programers conducted by SEDU. During the past year, the Consultation and Collaborative Division (CCD) has strengthened national and international collaborations of NIFS by extending the services and collaborations to various government and non-government organizations. With a dedicated staff as well as advanced research facilities, NIFS aims to reach greater heights in its future scientific endeavors.

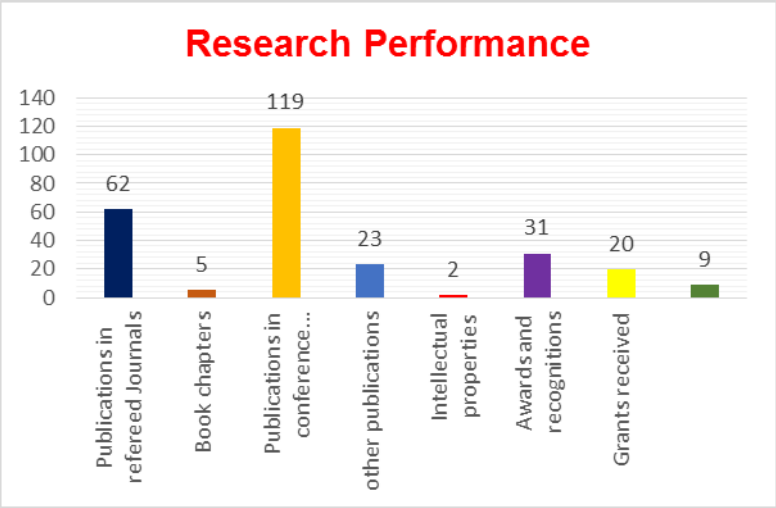
NIFS ORGANIZATION STRUCTRRE



Executive summary

Research Performance

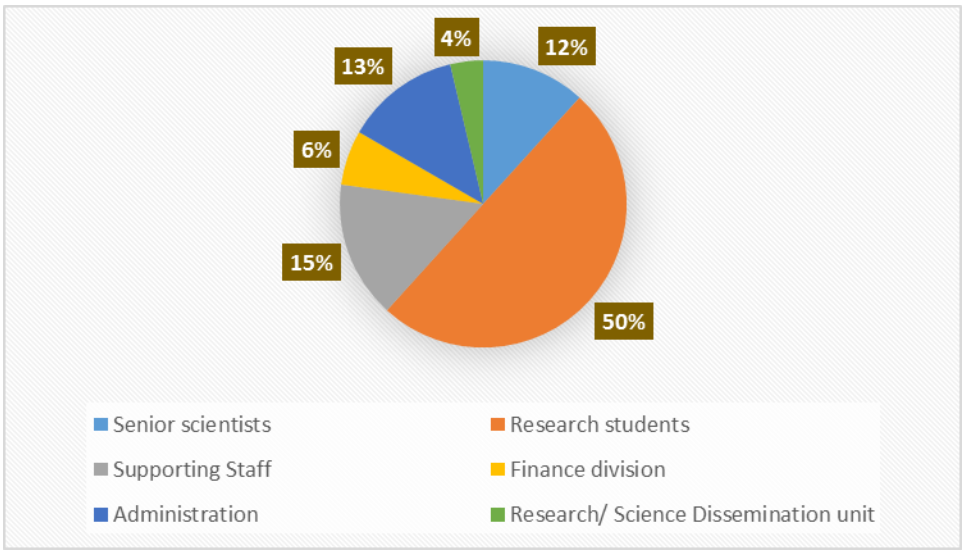
The purpose of fundamental research is to gain new knowledge. However, the knowledge gained may or may not lead to immediate practical applications. The research scientists have published their findings in reputed international journals and the Institute has gained a wide recognition as a leading research canter. Sixty-two research papers in referred journals including 60 in SCI/ SCI expanded journals, 05 book chapters and 119 conference papers/ abstracts have been published in the year 2015 along with two patents (one International and one National). In the year 2015, 09 research assistants obtained their postgraduate degrees (02 Ph.Ds. and 07 M.Phils.).



Human Resources.

During the year 2015; 81 research students carried out their postgraduate research were under the supervision of 19 senior scientists. The number involving in research projects comprised of 62% of NIFS Staff.

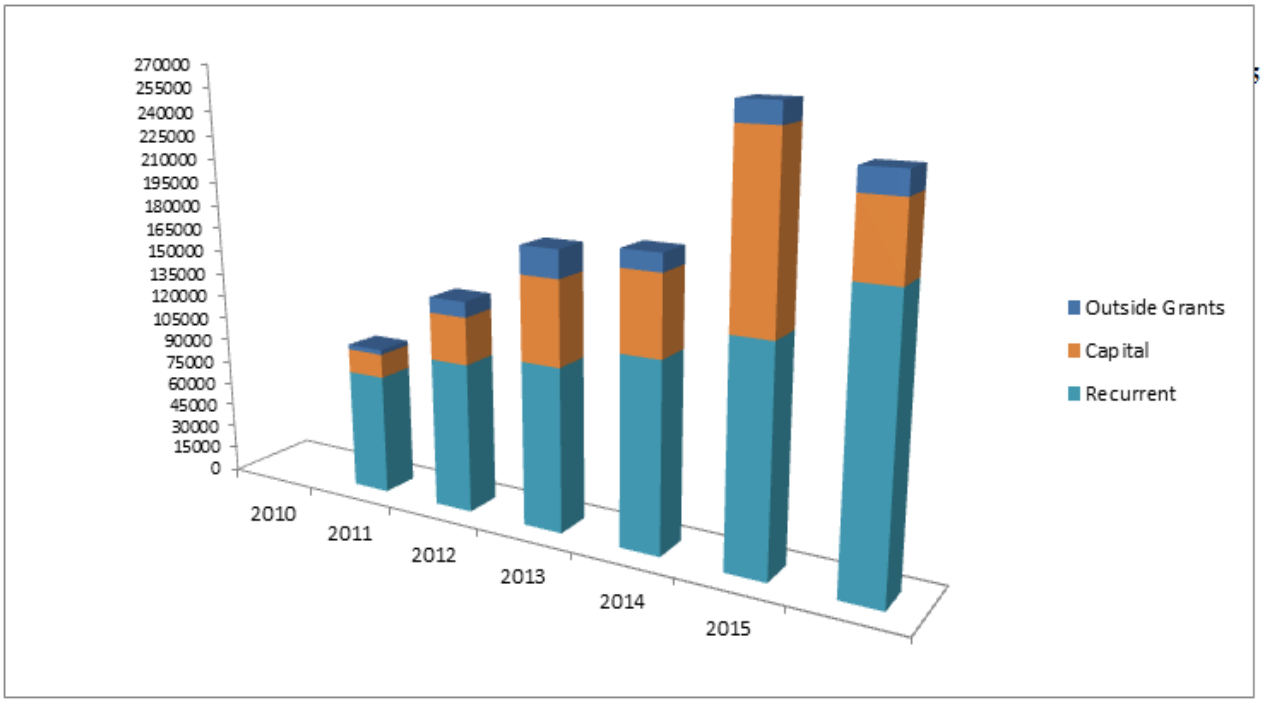
Division wise distribution of staff.



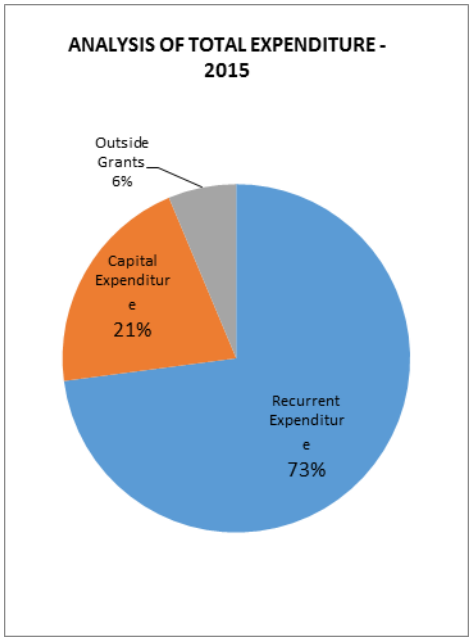
Financial Performance

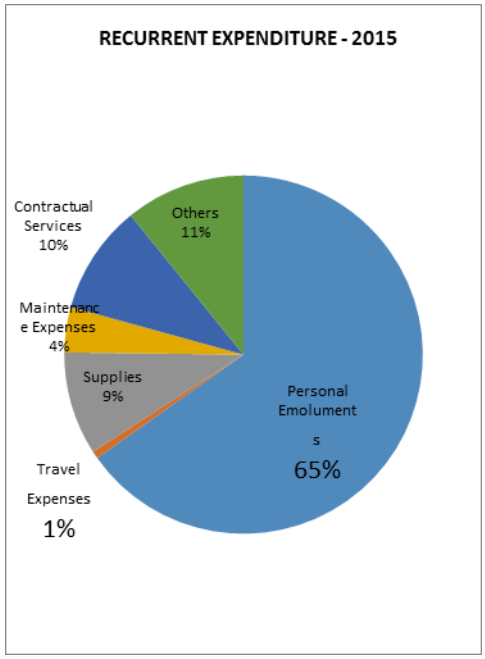
Total Annual Expenditure (Rs. '000)

Item	Item	2010	2011	2012	2013	2014	2015
Recurrent							
Personal Emoluments	Personnel Emoluments	51,945	64,723	71,734	84,561	88,317	113,461
Travel Expenses	Traveling Expenses	570	531	581	532	1,295	1,163
Supplies	Supplies	6,763	7,484	8,952	10,018	16,491	16,205
Maintenance Expenses	Maintenance Expenditure	5,063	5,454	3,796	2,891	8,496	7,105
Contractual Servises	Contractual Services	9,817	12,488	13,540	14,258	16,396	17,204
Others	Other Expenses	2,509	4,042	4,306	5,185	6,497	18,845
Recurrent Expenditure		**76,667**	**94,722**	**102,909**	**117,445**	**137,492**	**173,984**
Capital							
Capital Expenditure	Capital Expenditure	15,123	29,731	52,644	49,210	111,897	44,593
		15,123	**29,731**	**52,644**	**49,210**	**111,897**	**44,593**
Outside Grants	Outside Grants	2,996	9,752	17,425	11,068	12,512	13,626
		2,996	**9,752**	**17,425**	**11,068**	**12,512**	**13,626**
Total		**94,786**	**134,205**	**172,978**	**177,723**	**261,901**	**232,202**



Total Annual Expenditure for the past six years





The Government Tresury funds for recurrent expenditure showed an increased from Rs. 76.67 Mn to Rs. 173.98 Mn from 2010- 2015, while the capital expenditure increased from Rs. 15.12 Mn Rs 44.59 Mn. The expenditure from outside grants increased from Rs. 2.99 Mn to Rs. 13.63 Mn.

The total expenditure of Rs. 232.20 Mn in 2015 consisted of 73% recurrent 21% capital Tresury funds and 6% outside funds. (Outside research grant)

The total recurrent expenditure of Rs. 173.98 Mn in 2015 consisted of 65% personal emoluments, 10% contractual services, 9% suppliers, 4% maintenance, 1% traveling and 11% other expenditures.

SPECIFIC ACHIEVEMENTS IN 2015

Upgrading Sri Lankan minerals

Sri Lanka is famous for possessing a variety of economically useful minerals, however, they are mostly exported as cheap raw materials. In addressing this, our emphasis are on performing target oriented fundamental and advanced scientific investigations leading to develop our minerals for nano-technological and advanced industrial applications. Mainly, investigations on developing our natural vain graphite, which is the rarest and most valuable form of graphite, for specialized markets such as rechargeable batteries and Nano-materials have been carried out. It was done by developing novel processes for comprehensive purification (over 99.9%) and surface modifications of the local graphite. Interestingly, these highly upgraded local graphite already showed their promising characteristics for the use in rechargeable lithium-ion batteries and to fabricate highly valuable grapheme Nano material.

Fertilizers

The use of Biofilm bio fertilizers (BFBFs) developed by the Microbial Biotechnology project can cut down chemical fertilizer imports for agriculture and plantations up to 50%, which has many implications in national development. During 2015, this bio fertilizer was distributed mainly for tea and vegetable cultivations for about 10,000 acres in the country. It covered about 10 districts and obtained yield increases up to 40%. The BFBFs can address several issues like depletion of soil fertility, pest and pathogen infestations and other environmental stresses in agriculture and plantations. Therefore, the contribution of the introduction of the use of BFBFs to the country towards national development is multifaceted.

Plant Biology project

Biological control of mosquito larvae is necessary, to prevent mosquito borne diseases such as dengue, with restrictions on pesticide use. Our experiments with the small aquatic copepods showed high predation rates, particularly by organisms collected from Batticaloa and Kurunegala.

Degradation of dry forests is a global phenomenon. Our studies have established guides to evaluate forest degradation and strategies for restoration using "nurse trees" such as *Khaya seneghalensis* to establish young seedlings.

Small and medium entrepreneurs of textile industries discharge their dye effluents into public waterways. Our research has focused on finding low cost technologies such as bio sorption and phytoremediation to remove these toxic effluents. Bio char derived from waste by-products (sawdust, rice husk) successfully adsorbed cationic (Crystal Violet) and anionic (Congo red) dyes. Aquatic plants water lettuce (*Pistia stratiotes*) and Slavonia (*Sylvania molesta*) were also able to absorb these dyes through a processes phytoremediation studies. These species were also effective removers of phosphates and nitrates from water by phytoremediation.

Geothermal resources in Sri Lanka

Geothermal energy is a totally environment friendly source of energy and has not been explored at all in Sri Lanka, primarily due to technical know-how. During the period 2009 to present, the IFS initiated Sri Lanoka's first ever geothermal survey using the "Magnetolelluric method". A team of experts from UK worked with the IFS team. An extensive ground survey was conducted in the Northeast, North central, Eastern and Southern provinces. Data is now being processed and preliminary indications are there could be a major potential for geothermal energy in some parts of Sri Lanka mainly in the Hambantota area and in the Polonnaruwa region. Further research using geochemical and other geophysical methods such as magnetic and resistivity techniques were conducted around the geothermal zones.

Thermoelectricity Research Programme

Production of thermoelectricity generators (TEG) that can run on any locally available waste energy source (e.g. solar energy, waste heat from cooking or from factories, heat from burning straw, rice husk or dried weeds) will benefit the rural community with no access to the national grid. Producing TEG units as a local or domestic industry (similar to the production of solar water heaters in Sri Lanka) will provide employment to local people.

Developing micro and Nano level TEG modules for specific applications (e.g. bionic systems, microelectronics and Nano-science applications) will improve the local economy. A grant from the NRC was received for thermoelectricity research.

Estimating Eppawala Phosphate Deposit

Research project on Eppawala phosphate deposit, conducted under a grant from the National Science Foundation was successfully completed. A new, low-cost methodology to detect the boundaries of the phosphate ore, both on surface and subsurface, was developed using modern geophysical methods. It was discovered that the deposit extends beyond the previously known extent. A report was submitted to the NSF.

Evolution, Ecology and Biodiversity

9 research papers (6 SCI/ 3 other) were published for 2016. 38 species described, of which 22 were new to science. Additionally, 16 species were described in 2016. Our research was highlighted in a special program of the Canadian Broadcasting Corporation (CBC) and in several local newspapers

Nutritional Biochemistry project

In year 2015 Nutritional biochemistry focused on various aspects of functional and nutritional properties of foods and covered a wide area like functional and nutritional properties of bioavailability of food, food safety, novel method development, and functional foo product development. Recently, there is an interest towards usage of medicinal plants for treating several disease conditions. Thus s study was conducted to investigate the scientific evidences for exerted beneficial properties such as antioxidant, anticancer, hypoglycaemic and hypolipidaemic activities. A study was conducted to assess the *in vitro* functional properties of hot water extracts of 10 commonly used medicinal plants in Sri Lanka. Among the tested plants, the Nellie extract was found to extract extremely high antioxidant and amylase inhibitory activities.

There has been an explosion of consumer in the health enhancing functional foods at present. Nutritional Biochemistry project at NIFS with the collaboration of Department of Animal Science, Faculty of Agriculture, University of Peradeniya, developed two novel functional

foods. Avocado Incorporated Butter and Maringa leaf powder incorporated soya drink with various health benefits.

Heavy metals are incorporated into poultry as a supplementary diet, to fulfil protein requirement and as a mineral supplements. Thus heavy metal concentration in some Poultry tissuse were higher than the permissible level determined by WHO.

Photochemistry Project

The main objective of the project is to find an alternative energy resource. Hydrogen is considered to be the future energy source due to rapid depletion of fuel energy. It can be produced by mainly splitting of water which is one of the research topics that is unresolved in chemistry. Here at NIFS, we develop catalysts to produce hydrogen in an economical way by using solar energy. Additionally, we fabricate low-cost sensitized solar cells by mimicking photosynthesis. The project carry out synthesis of various nanoparticles as well as 1-D structures for the application of solar cells as well as catalysis.

Chronic kidney disease (CKD) is considered to be a worldwide public health problem and receiving increased global attention because of a significant increase in the prevalence of the disease. CKD of unknown aetiology (CKDu) is prevalence in some regions of Sri Lanka and the term “unknown aetiology” refers, because the disease is not associated with any known risk factors but suspected to be occupational and environmental causes as the major reason. In this project, we attempt to identify whether there is any correlation to the quality of drinking water to the prevalence of CKDu in the region.

Social welfare through health
Research from Cell Biology Project

We used molecular tools to identify microorganisms as well as to investigate the mechanisms of diseases causation by microbes and other environmental factors. We focused our efforts both on basic as well as on applied sciences.

In the area of pulmonary diseases, we developed a molecular assay to detect mutations in *Mycobacterium tuberculosis* complex (MTC) strains [the causative agent for tuberculosis (TB)]and were able to obtain the Sri Lankan patent (17423) for it. This assay could be used

to direct rapid diagnosis of drug susceptibility in tuberculosis (TB) which will reduce the time taken for traditional culture based assay. In molecular epidemiological studies on TB, we found that *M. tuberculosis*_strains isolated from TB Patients of Kandy had originated both from ancestral and modern lineages which is important in controlling TB transmission in the country.

Gene expression analysis in chronic kidney disease of uncertain etiology (CKDu) using a selected gene panel showed oxidative stress in CKDu endemic areas with up regulation of the particular genes, and currently studies are in progress for the identification of biomarkers for CKDu.

In the area of cyanobacteria research, first comprehensive study on diversity, molecular phylogeny and cyanotoxin (microcystin) production, was completed in which cyanobacteria belonging to 37 genera were identified with DNA sequencing we were the first to record genus *chroococcidiopsis* in Sri lanka. Additionally we confirmed the presence of cyan toxin producing cyanobacteria species in dry zone lakes including *cylindrospermopsis raciborskii* species in Anuradhapura reservoirs, and in well waters in chronic kidney disease of uncertain etiology (CKDu) prevailing areas of Sri Lanka.

Research Areas

Biological Sciences Biological Sciences

Biofuel Production/ Carbon sequestration & Management
Cell Biology
Ecology & Environmental Biology
Functional Food Product
Development Microbial
Biotechnology
Natural Products
Nutritional Biochemistry
Plant Biology

Physical Sciences

Chemical & Environmental Systems Modeling
Condensed Matter Physics & Solid State
Chemistry Nanotechnology/Physics of Materials
Photochemistry
Renewable Energy, Natural Resources & Cleaner Environment
Single Bubble Son luminescence

R.Renuka Ratnayake

Snior Research fellow
renukar@ifs.ac.lk94-812232002
tp://www.ifs.ac.lk/research_units/biofuel_production.php
tp://www.ifs.ac.lk/research_units/carbon_sequestration.php

Biofuel production / Carbon Sequestration and Management

Currently research is being carried out in two main areas; Biofuel and soil C sequestration with sub projects in each category. A fair amount of studies have been reported and some data are available on the above ground C - sequestrations of the major vegetational types of Sri Lanka. However, very little or no information is available on the below ground or soil C sequestration. In consideration of the importance as well as the long term stability of soil stored C, it is essential to fill this gap of knowledge on soil C-sequestration in Sri Lanka with respect to the country's carbon budget. Therefore in this project, soil C sequestration potential and its dynamics will be studied in the different major vegetation types of Sri Lanka. Major vegetations of Sri Lanka include natural and plantation forests, agricultural plantations, farm lands and small holder cultivations, wetland paddies, dry and wet grasslands or patanas, mangroves etc.

The biofuel project aims to explore the microbial flora of Sri Lanka to isolate efficient degraders of cellulose, hemicellulose and lignin, study the effect of biofilms and/or co-cultures on degradation of cellulosic biomass. Lignocellulosic materials from plants are a rich source of sugars. However, current production processes are economically unviable partly due to the costs of pre-treatment and hydrolyticezymes. The present project aims to study possible enhancement of enzyme production by formation of co-cultures or biofilm formation. In addition, the possibilty of overcoming nitrogen limitation during enzyme production by co-culturing cellulolytic fungi with nitrogen fixing bacteria is being studied. For the purpose of biological pre-treatment, a number of basidiomycetes have been grown *in vitro* and screened for ligninolytic enzymes and their potential for degrading lignin is being explored. Organic component of algae could also be used as raw material for biofuel production. Algae are rich in poly unsaturated fatty acids hence; enhance the potential as a source for biofuel. This research examines the possibilities of using cyanobacteria and algal species available in fresh water bodies of Sri Lanka for biofuel production.

Assessment and Mapping of Soil C Stocks in Knuckles Forest Region of Sri Lanka

Forest soils play an important role as a carbon sink, which means that it can absorb and hold carbon for hundreds to thousands of years without releasing it as CO_2 into the atmosphere. This study is based on soil C sequestration in different landuse types of Knuckles Forest Region; where a wide range of climatic conditions and vegetation types are available. Montane forests (MF), Sub Montane forests (SMF), Open and Sparse forests (OSF) and Grasslands (GL) were selected for the study (Figure 1).

Figure 1. Sampling in Sub Montane Forest

In addition to C sequestration, soil nutrient levels of these landuse types were also estimated. Results showed that TOC content was significantly highest in MF followed by SMF and lower in both OSF and GL. Montane forests also recorded higher MBC, LC and WSC contents (0.14 %,
715.2 mg/kg, 0.46 % respectively) compared to the other studied landuse types. Soil C stocks varied significantly ($p<0.05$) among these forest types, where MF recorded the highest soil C stock in top soil layer (0-15cm). The results show that MF and SM forests have a greater ability of sequestering compared to other studied landuse types in the Knuckles forest region.

Carbon stocks and carbon fractions in paddy soils of northern Sri Lanka

Paddy represents a large portion of global agriculture and grown largely in South and East Asian countries. Soil organic carbon accumulation in paddy ecosystems was faster and more pronounced than the other arable ecosystems as organic matter decomposition is lessened in lowland rice fields, apparently due to excessively reduced conditions. However no research has been done in Sri Lanka to study soil C stocks in lowland paddy soils. The objective of this study was to assess the total organic carbon and its fractions and nitrogen availability in the paddy soils of Northern Province of Sri Lanka. This study was carried out in Jaffna, Kilinochchi, Vavuniya, Mannar, Mullaitheevu districts of Northern Province of Sri Lanka. There were significant variations in total organic carbon and its fractions, nitrate and ammonium availability among soil great groups of paddy fields of Northern Province of Sri Lanka. TOC content of top soils in ton/ha was highest to the grumusols (54.83 tons/ha) and lowest to the regosols (10.55 tons/ha) in paddy fields of Northern Province.

Biodiesel production from freshwater cyanobacteria and micro algae of Sri Lanka and their morphological and molecular characterization

Biofuels are considered as an important means of reducing greenhouse gas emissions and increase energy security by providing a viable alternative to fossil fuels. Algae biomass is a potential source of 3rd generation biofuel that could surpass all the others due to its rapid growth and extremely high yield potential. Therefore, the aims and goals of the present study are: Morphological identification of cyanobacteria and other algae in fresh water bodies of Sri Lanka as a suitable feed stock for biodiesel production, Optimizing semi-mass culturing of selected cyanobacteria and other algal species, Isolating the other algal products and value added compounds of commercial interest from the residue of algal biomass, Extraction of fatty acids from selected cyanobacteria and other algal species, Molecular characterization of isolated cyanobacteria and other algae, Producing bio diesel from extracted lipids. For the last 12 months a total number of 52 uni algal cultures were isolated from

25 fresh water bodies representing three climatic zones of Sri Lanka (Figure 2). The morphological identification of the isolates were also carried out. Isolates were tested for antioxidant, anti-pathogenic activities. The results indicated that cyanobacteria are rich in antioxidants with anti-pathogenic properties.

Figure 2. Semi mass culturing of cayanobacteria

At the same time, different type of pigments such as phycoerytherin (PE), phycocyanin (PC) & allophycocyanin (APC), Chlorophyll-*a* (Ch-*a*), Chlorophyll-*b* (Ch-*b*) and Carotene (C_{X+C}) were extracted from selected cyanobacteria which can be used in food and pharmaceutical industry. Also cyanobacteria species were tested for treating waste water and found that there is a potential to use in waste water treatment.

Isolation, identification and screening of microbial strains and development of biofilm/co-cultures for lignocellulose degradation

The enzymes involved in degradation of lignocelluloses include cellulases, hemicellulases lignin degrading enzyme Cellulases can be further categorized as endoglucanases, exoglucanases and β glucosidases. Different microbes produce different proportions of these enzymes. Therefore, co-culture of different microbes may result in a more efficient mixture of enzymes for degradation of enzymes. Also, biofilms of the enzyme producing may have enhanced expression of the enzymes. Among the fungal-fungal co-cultures tested so far, those between *Trichoderma reesei* and *Eupenicillium* sp have been found to produce more efficient enzyme mixture than their monocultures. Fungal-bacterial co-cultures have been found to be less effective.

Nitrogen level in the medium is another factor that can limit enzyme production. Co-culture of enzyme producing fungi with nitrogen fixing bacteria is being studied to determine whether the bacteria can replenish nitrogen in the medium. Lignin degrading enzymes (laccases, Mn peroxidases, lignin peroxidases etc) are mostly produced by the basidiomycetes group of fungi. So far 42 different basidiomycetes have been isolated and screened for the lignin degrading enzymes. Isolates with high enzyme activities were tested for their ability to degrade lignin in culture medium. *Pycnoporus sanguineus* (Figure 3) was found to degrade alkali lignin in monoculture, while isolate M14 was found to degrade akali lignin in mixed culture with *Cellulomonas biazotea*.

Figure 3. *Pycnoporus sanguineus*: Capable of degrading lignin

Ph.D. Students : K. Mohanan, Md. Fuad Hossain
M.Phil. / M.Sc. Students : Kumari Rajapaksha, Bimali Kangararachchi

Key publications

1) Ratnayake RR, Seneviratne G, Kulasooriya SA (2011). The Effect of Cultivation on Organic Carbon Content in the Clay Mineral Fraction of Soils. Int. J. Soil Sci. 6: 217-223.

2) Ratnayake RR, Seneviratne G, Kulasooriya SA (2013). Effect of soil carbohydrates on nutrient availability in natural forests and cultivated lands in Sri Lanka. Eurasian Soil Sci., 46: 579-586.

3) Mohanan K, Ratnayake, RR, Mathaniga, K, Abayasekara CL, Gnanavelrajah N. (2014). Effect of co- culturing of cellulolytic fungal isolates for degradation of lignocellulosic material, J. Yeast Fungal Res., 5: 23-30

From Left: Standing: Ms. HATA Hangawatta, Ms. IK Edirisinghe, Ms. K Thayalini, Ms. R Nadarajah, Ms. SMS Malika, Ms. J Kanchana, Mr. K Mohanan, Mr. MD.F. Hossain, Sitting: Ms. RBK Ranawaka, Ms. S Jayalath, Ms. RPSK Rajapaksha, Dr. RR Ratnayake, Ms. PWD Shamari, Ms. GGNT Ariyasinghe

Dhammika Magana-Arachchi

Cenior Research Fellow
nayomam@yahoo.com
94-812232002
ttp://www.ifs.ac.lk/research_units/cell_biology.php

Cell Biology; understanding specific diseases and microorganisms at the molecular level

In the Cell Biology lab, we use molecular tools to identify microorganisms as well as to investigate the mechanisms of diseases causation by microbes and other environmental factors. We focus our efforts on basic and applied science and there is a clear need in each of these research areas, and their underlying biology is fascinating and tractable.

In the area of cyanobacterial research, first comprehensive study on diversity, molecular phylogeny and cyanotoxin (microcystin) production, was completed in which cyanobacteria belonging to 37 genera were identified with DNA sequencing. We were the first to record genus *Chroococcidiopsis* in Sri Lanka and currently their toxin production is being investigated. Additionally we confirmed the presence of cyanotoxin producing cyanobacterial species in the dry zone lakes including *Cylindrospermopsis raciborskii* species in Anuradhapura reservoirs, and in well waters in chronic kidney disease of uncertain aetiology (CKDu) prevailing areas of Sri Lanka.

In the area of pulmonary diseases, we developed a molecular assay to detect mutations in *Mycobacterium tuberculosis* complex (MTC) strains and were able to obtain the Sri Lankan patent (17423) for it. This assay could be used to direct rapid diagnosis of drug susceptibility in tuberculosis (TB) which will reduce the time taken for traditional culture based assays. In molecular epidemiological studies on TB, we found that *M. tuberculosis* strains isolated from TB patients of Kandy had originated both from ancestral and modern lineages, which is important in controlling TB transmission in the country.

Currently our studies are based on biomarker identification for CKDu, rapid differentiation of non-tuberculous mycobacteria (NTM) from MTC, Programmed Cell Death (PCD) and cyanotoxin release from cyanobacterial cells and the airborne microbes in atmospheric particulate matter.

Gene expression analysis in chronic kidney disease of uncertain aetiology (CKDu)

CKDu is an increasing health problem in certain agricultural regions of the tropical world including SriLanka. Gene expression analysis was used to determine cause of the disease and identify possible biomarkers. Preliminary studies using a selected gene panel showed oxidative stress in a CKDu endemic area with up regulation of the GCLC and GSTM1 genes. Regulation of kidney injury related genes, FN1 and KIM1, was also noted. The study was thus expanded to analyze whole transcriptome patterns in blood of CKDu patients by using microarrays. Differentially expressed genes (fold change ≥ 2 or ≤ 0.5) specific to each of Stage 2 (403 genes), Stage 3 (612 genes) and Stage 4 (31 genes) CKDu were identified (Figure 1). Seven genes were identified as commonly differentially expressed in all the three stages. These genes have functions related to hypertensive response (ADM), gap junction channel activity (GJB4) and infectious/immune response (IFIT1, PI3, DEFA1, HBZ, RN7SK). The results are being analyzed further to understand underlying molecular mechanisms.

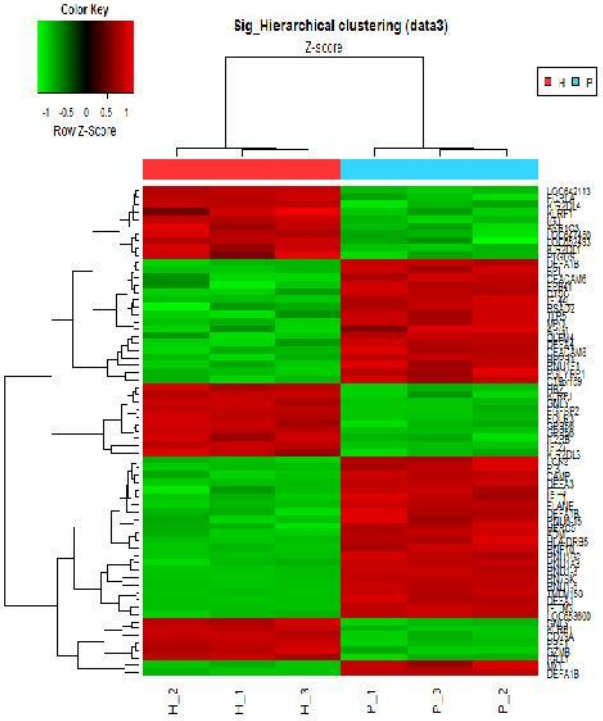


Figure 1. Cluster image of Stage 4 CKDu vs Healthy

Molecular epidemiology of tuberculosis in Central Province

The study was performed on 150 isolates obtained from sputum specimens of patients having tuberculosis (TB), which included patients from the general population attending the Chest Clinic, Kandy, patients having TB in Bogambara prison, Kandy and estate workers having TB. Data revealed that the majority of irculating *Mycobacterium tuberculosis* (MTB) strains in the Kandy district belonged to 19 distinct families, including six major families; East-African-Indian (EAI-55.7%), Haarlem (20%), Beijing (8.6%), Central European family T (6.5%), European Family X (5.2%) and Central and Middle Eastern Asian (CAS-0.6%).

A few strains of MANU, EAI3-IND, EAI6-BGD1and *M.tuberculosis* S sub-lineages were also identified. The results of this study showed a high degree of polymorphism in the DNA fingerprinting patterns of MTB isolates.

Beijing strains were only identified among the general population and Haarlem3 was the predominant strain among the estate workers. There was a close epidemiological relationship between the isolates of the prisoners and the estate workers in the the populat studied. The study concluded that the use of 15 loci MIRU-VNTR typing combined with spoligotyping is feasible for a country with a moderate TB incidence like Sri Lanka This is the first study in Sri Lanka in which the MIRU-VNTR pattern of *M. tuberculosis* strains in conjunction with spoligotyping in a population has been examined.

Non-tuberculous Mycobacteria (NTM)

Non-tuberculous Mycobacterial infections present with clinical signs that are similar to patients with tuberculosis (TB), causing clinical misle ding during therapeutic actions. Even though human pulmonary infections due to *Mycobacterium tuberculosis* complex (MTC) is common, other species of *Mycobacterium* causing diseases have been identified and found to be increasing in recent years. Mycobacteria have a spectrum of virulence and different susceptibilities to antibiotics. Thus, it's important to rapidly distinguish NTM from MTC to administer appropriate treatment. SYBR Green mediated multiplex real time PCR assay could be used as an effective tool for the diagnosis of pathogenic *Mycobacterium* species.

In our study multiplex real time PCR was used to rapidly identify *Mycobacterium* species present in bronchial washings. Twenty six isolates were identified as *Mycobacterium* genus positive. Two *Mycobacteriumtu berculosis* isolates, three *M. avium* complex isolates and two *M. chelonae-M.abscessus* group isolates were further identified (Figure 2). The drug susceptibility was tested for the identified isolates and majority of the identified NTM species was resistant to clarithromycin. All strains were sensitive to amikacin while only a few isolates were resistant to ciproflaxacin.

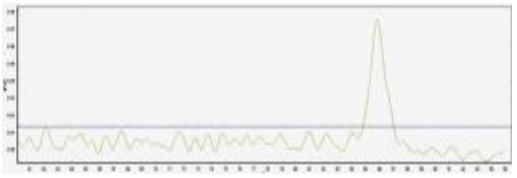


Figure 2. SYBR Green mediated Real Time PCR Melting curve (Tm = 85.8 C) indicating the presence of the *Mycobacterium* genus.

Programmed cell death in cyanobacteria

Autocatalysis of Programmed Cell Death (PCD) is common in cyanobacteria. *Microcystis spp* are frequently occurring toxigenic bloom formers and is common in eutrophicated water bodies in Sri Lanka. Though there are non-toxic *Microcystis* strains, most of them produce hepatotoxic and potential carcinogenic microcystin. Our hypothesis is that secretion of extracellular microcystin into the surroundings might have a correlation with the age of the cell and physical stresses of the environment. *Microcystis aerugiosa* (EF051239) culture isolated from Beira Lake, Colombo was used for the study. Artificial induction of PCD by hydrogen peroxide (H_2O_2) revealed the positive correlation with protein damaging activities (pigment degradation). Molecular biological identification of caspase related geneses (metacaspases; p20 domain) in *M. aerugiosa* confirmed the genetically mediated cell death

events. Studies are being carried out to determine the relationship between apoptosis and toxin releasing.

Some Cyanobacteria have ability to tolerate stringent environments and they are being called as extremophiles. A unicellular cyanobacterium, *Gloeocapsa* sp.(KU375123) was isolated from a Graphite sample, collected from Kahatagaha Graphite Mine, Kurunegala (Figure 3).

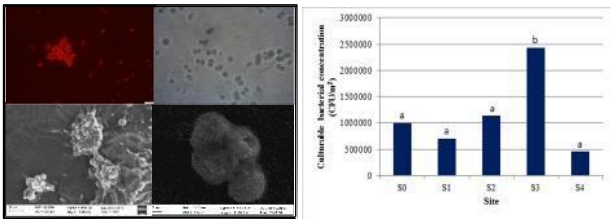


Figure 3. Fluorescent, light and scanning electron microscopic visualization of *Gloeocapsa* sp (left).
Figure 4. Culturable bacterial concentration (CFU/m^2) in five sites of Kandy city (right).

Study of airborne microorganisms

Atmospheric particulate matter causes range of human and eco system health problems increasing the budget allocation for mitigation strategies to minimize their adverse effects. Therefore for the first time in Sri Lanka the particulate matter associated micro-organisms are being identified and quantified in highly traffic congested areas in Kandy city using sequencing and enumeration methods (Figure 4).

The bacterial species *Sphingomonas* sp., *Pseudomonas aeruginosa, Pseudomonas monteilii, Klebsiella pneumonia, Ochrobactrum intermedium, Leclercia ade carboxylata, Exiguobacterium acetylicum, Exiguobacterium indicum, Bacillus pumilus, Bacillus aryabhattai, Bacillus megaterium, Bacillus amyloliquefaciens, Serratia marcescens, Providencia rettgeri* and *Kocuria kristinae* were identified which were opportunistic pathogens. The culturable microorganisms were relatively less when compared to total microrganisms in the atmosphere (0.0% to 28%). In the future, quantification of total microorganisms using molecular techniques (real time PCR) will be carried out.

Ph.D. student: S Sayanthooran
M.Phil. students: TP Keerthirathne, RWK Amarasekera
M.Sc. student: EGCK Priyadarshika

Key publications

1) Magana-Arachchi DN,* Wanigatunge RP, Liyanage M (2011). Molecular characterization of cyanobacterial diversity in Lake Gregory, Sri Lanka. Chinese Journal of Oceanology and Limnology. 29 (4): 898-904.

2) Magana-Arachchi DN*, Wanigatunge RP (2013). First report of genus *Chroococcidiopsis* (cyanobacteria) from Sri Lanka: a potential threat to human health. J.Natn.Sci.Foundation Sri Lanka 41(1): 65-68

3) Weerasekera D, Magana-Arachchi DN,* Madegedara D, Dissanayake N, Thevanesam V (2015). Genetic diversity of *Mycobacterium tuberculosis* isolates obtained from three distinct population groups in the Central Province, Sri Lanka Asian Pac J Trop. Dis. 5(5): 385-392

From Left: Ms. TP Keerthirathne, Ms. EGCK Priyadarshika, Mr. S Sayanthooran, MS. EMUA Ekanayake, Ms. RWK Amarasekara

Suresh P. Benjamin

Associate Research Professor
Suresh.Benjamin@gmail.com
+94-812232002
http://www.ifs.ac.lk/research_units eeb.php

Ecology and Environmental Biology

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

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

Arthropod diversity estimates can be useful as indirect assays of ecosystem function or productivity or as direct estimators of ecosystem responses to human induced change. The groups of our focus are pseduoscorpions, spiders, bees and orchids, groups of high conservation necessity. These findings are then shared through papers published in peer reviewed journals.

Diversity of Goblin Spiders in Sri Lanka Revealed by a Genus Level Phylogeny of the Family

Dwarf hunting spiders or goblin spiders (Oonopidae) are Spiders were collected by leaf litter sifting, general hand collecting, sweeping and beating off bushes and trees. All materials were preserved in either 70% or 100% ethanol an extremely diverse spider family with over 1444 for morphological and molecular analysis respectively. described species in 113 genera worldwide. Members of Male palps and epigynes were dissected and kept in this family are small (1-4 mm), haplogyne, six eyed species that dwell in litter or in the canopy. They do not build webs. Sri Lanka hosts a large diversity of oonopidae, with 23 species in 8 genera known. So far, no specific extensive study has been done for oonopids in Sri Lanka. The present study is aimed at assessing the diversity of goblin spiders in the island. Another aim is to infer the phylogeny of the family based on DNA sequence data.

Field visits were conducted in 115 sites in all provinces of Sri Lanka. Litter samples were sifted and left over night in *Ballus*, *Marengo*, *Rhene*, *Colaxes*, *Hyllus*, *Flacillula*, *Ptocasius*, *Plexippus*, *Epidelaxia*, *Bianor*, *Harmochirus*, *Cyrba*, *Siler*, *Simaetha*, *Stenaelurillus*, *Hispo*, *Thyene*, a Winkler extractor. The collected specimens were *Tamigalesus*, *hiania*, *Hasarius*, *Phausina*, *Irura*, *Epocilla*examined using an Olympus SZX 7 stereomicroscope. Our collections consist of 310 oonopid spiders of seven and *Phaeacius* have been recorded. To date, nearly 550 specimens have been identified up to genus and/or reported genera (*Aprusia*,*Brignolia*,*Camptoscaphiella*,species *Ischnothyreus*, level. *Orchestin*a, *Opopaea* and *Xestaspis*) and eight new genera for the country. Three new species of the genus *Xestaspis* (*X. nuwaraeliya*, *X. padaviya*and *X. pophami*) and three new *Brignolia*species are described. DNA was extracted from selected specimens and PCR was performed to amplify 18S/28S fragments. Phylogenetic analysis was performed using combined 18S/28S sequenced data (2782 bp). Phylogenetic trees were constructed using MEGA 6.06 and TNT.

In addition, Sri Lankan Oonopids are included for the first time in a worldwide molecular analysis.

Xestaspis kandy Eichenberger 2012, male in life

Molecular Phylogeny and Systematics of Jumping spiders (Family: Salticidae) from Sri Lanka

The jumping spider (family Salticidae) contains more than 595 genera and about 5838 described species arranged in 7 subfamilies, making it the largest family with about 13% of all spider diversity. Sri Lanka possesses a relatively large jumping spider fauna of 64 species placed in 48 genera, with a large endemic component. However, this might be only a fraction of its true diversity. The aim of the project is to collect, identify, document and using

morphological and molecular methods to characterize the jumping spider diversity of the island.
Spiders were collected by leaf litter sifting, general hand collecting, sweeping and beating off bushes and trees. All materials were preserved in either 70% or 100% ethanol an extremely diverse spider family ith over 1444 for morphological and molecular analysis respectively. described species in 113 genera worldwide. Members of Male palps and epigynes were dissected and kept in this family are small (1-4 mm), haplogyne, six eyed methyl salicyclate for 4-5 hours for drawing. DNA extraction, PCR conditions and gel electrophoresis were followed based on the manufacturer's and lab protocols.

To date we have identified three new genera for Sri Lanka: *Macaroeris*, *Habrocestum* and *Bristowia*. Several species new to science and new records of the genera *Habrocestum*, *Phintella*, *Carrhotus*, *Cosmophasis*, *Evarcha*, *Curubis*, *Telamonia*, *Onomastus*, *Menemerus*, *Ball*,*Morengo*, *Rhene*, *Colaxes*, *Hyllus*, *Flacillula*, *ptocasius*, *Plexppus*, *Epidelaxia*, *Binaor*, *Harmochirus*, *Cyrba*, *Siler*, *Simaetha*, *Stenaelurillus*, *Hispo*, *Thyene*, *Tamigalesus*, *Thiania*, *Hasarius*, *Phausina*, *irura*, *Epocilla and Phaecius* have been identified up to genus and/or species level.

To date we have identifiedthree new genera for Sri Lanka: *Macaroeris*, *Habrocestum* and *Bristowia*. Several species new to science and new records of the genera *Habrocestum*, *Phintella*, *Carrhotus*, *Cosmophasis*, data. *Evarcha*, *Curubis*, *Telamonia*, *Onomastus*, *Menemerus*, Field visits were conducted in 115 sites in all provinces of Sri Lanka. Litter samples were sifted and left over night in species level.

Onomustus nigricauda Simon 1900, male in life

Taxonomic revision of theGenera Dendrobium and Bulbophyllum (Orchidaceae) of Sri Lanka

Orchidaceae is one of the largest plant families in Sri Lanka found in all terrestrial vegetation types. Field work and data analysis of this project have now been completed. We were able to cover 47% of the photo documentation (62% of *Dendrobium* and 36% of *Bulbophyllum*). We have found six species of *Dendrobium* out of eight and seven *Bulbophyllum*out of eleven species reported for Sri Lanka. A further objective of this survey is to determine host plant specificity of our study species, which has now been completed.

Dendrobium heterocarpum, Wall, exLindl

Vegetative traits of all specimens were measured using a caliper and a measuring tape and dissected floral parts were drawn with the aid of a stereomicroscope equipped with a camera lucida. Vegetative and floral morphometric data will be analyzed using the delta software package. Results of this project have been reported in two manuscripts that are currently under review.

Systematics, Biogeography and Evolution of Stephanopinae Crab Spiders (Araneae: Thomisidae)

Crab spiders, family Thomisidae, are a specious family.They are mainly active during the day and ambush insects with their well-adapted first and second pairs of legs. Thomisids are behaviorally versatile exhibiting complex behaviors. Understanding the phylogenetic structure of this large family has always been problematic. Through this project, we aim to provide a stable phylogenetic hypothesis for the family Thomisidae by analysis of morphological and DNA sequence data. This study will also form the basis of future revisionary

work of the family, its biodiversity and conservation. As a part of this project several genera have been revised and one new genus and three new species described.

M.Phil. Students: Ms. Nilani Kanesharatnam, Ms. Sasanka Ranasinghe, Ms. Ilesha Sandunika Ileperuma Arachchi
Post-doc: Dr. Crisenthiya I. Clayton

Key Publications

1) Benjamin SP (2010). Revision and cladistic analysis of the jumping spider genus *Onomastus* (Araneae, Salticidae). Zoological Journal of the Linnean Society, 159: 711-745.
2) Benjamin SP (2011). Phylogenetics and comparative morphology of crab spiders (Araneae: Dionycha, Thomisidae). Zootaxa 3080: 1-108.
3) Benjamin SP (2015). Model mimics: antlike jumping spiders of the genus *Myrmarachne* from Sri Lanka. Journal of Natural History 49: 2609-2666.

From Left: Dr. Crisenthiya I. Clayton, Ms. Nilani Kanesharatnam, Ms. Ilesha Sandunika Ileperuma Arachchi, Ms. Sasanka Ranasinghe

Viduranga Y. Waisundara

Research Fellow
viduranga@ifs.ac.lk
Tel: + 94 81 2232002

Functional Food Product Development

Functional food can be defined as a food products capable of reducing the onset of disease conditions and/or promoting good health. The Functional Food Product Development project was initiated in April 2013 with the intention of combating disease conditions which are significantly prevalent among the population of Sri Lanka. The primary focus of the project is to identify food items which demonstrate the ability to prevent or contain disease conditions. A special emphasis is laid on food products which are already part of the diet and contain bioactive constituents which have been scientifically identified to possess functional properties. The research group primarily targets at identifying food products which are able to combat diabetes, which is currently on the rise given Sri Lanka's recent entry into the lower middle income group of countries.

Currently, two major aspects are being investigated under this project: (1) Evaluation of the bioaccessibility of phenolic compounds in existence in edible plant products, and (2) increasing the bioaccessibility bioactive compounds by fermentation. Bioaccessibility is an important property when assessing the ability of a food product to combat disease conditions. Broadly, it refers to the release and subsequent availability of bioactive compounds for absorption via the gastro-intestinal tract. A higher bioaccessibility of bioactive compounds would infer an elevated ability of the food product to deliver the therapeutic effects to the human physiological system upon consumption. While *in vitro* methods have been used to determine the bioaccessibility and bioavailability of individual bioactive compounds, the focus of the activities of this research project is the gastric and duodenal digestion process – two major sites in which bioactive compounds are subjected to enzymatic activities, and therefore, structural changes.

Application of the Kombucha 'Tea Fungus' for enhancement of bioactive compounds in locally available plant products

Microbial fermentation has been known to result in the enhancement of therapeutic properties in beverages containing phenolic compounds. This category of compounds have been associated with the ability to prevent the onset of many non-communicable disease conditions. Thus, the objective of this project was to increase the bioaccessibility of phenolic compounds in commonly consumed beverages by fermentation with the Kombucha 'tea fungus'. This particular type of fermentation has been known to result in beverages containing enhanced therapeutic properties without the need to incorporate additional ingredients. The method is simple and can be applied in any domestic condition without a significant cost. The ability of this fermentation process to be applied for the development of novel beverages is currently being explored, since the processing method could applied in industrial as well as domestic contexts without significant hassle.

Figure 1. Black tea fermented with the 'tea fungus' – the resulting beverage has a light orange, sparkling hue as a result of the metabolic activities of the microbes present in the tea fungal mat.

As such, the ability of the 'tea fungus' to ferment coffee and king coconut water was explored and the outcome resulted in two novel functional food products with appealing sensory properties. Coffee contains several beneficial antioxidants and is one of the richest known sources of chlorogenic acid. As a phytochemical of dietary importance, coffee is considered as one of the major dietary sources for the incorporation of chlorogenicacid into the diet. Thus, it was of interest to determine whether the antioxidant potential of coffee can be enhanced through naturally occurring biochemical processes such as fermentation with the 'tea fungus'. As for king coconut water, recent evidence suggests king coconut water to possess functional properties which are associated with many health benefits. However, in most studies, the antioxidant properties of king coconut water were verified *in natura* and have been identified to reduce drastically with the use of thermal treatments, or the actions of acids or alkaline as well as with the degree of maturation of the fruits. Thus, it was assessed whether any demonstrated antioxidant and starch hydrolaseany demonstrated antioxidant an dstarch hydrolase inhibitory properties of king coconut water can be enhanced by fermentation with the 'tea fungus'.

Overall, an enhancement of the antioxidant and starch hydrolase inhibitory potential of both coffee as well as king coconut water through the addition of the 'tea fungus' was observed. This had occurred in correlation with an enhancement of phenolic compounds present in both beverages. Both these studies serve as a proof-of- concept of a new food product development process, where the resulting beverages could be identified and

promoted as a functional food product which can be easily prepared in households and even scaled-up for commercial production of novelty functional beverages.

Investigation of the antioxidant and starch hydrolase inhibitory activities of herbs and spices in an *in vitro* model of digestion

Measurement of antioxidant and starch hydrolase inhibitory activities before and after *in vitro* digestion offers a method of ranking food products in order of their protective and disease preventive capabilities. For this particular study, herbs and spices which are commonly consumed in Sri Lanka were assessed for their ability to maintain any demonstrated antioxidant and/or starch hydrolase inhibitory properties when subjected to gastric and duodenal digestion. Antioxidants found in herbs and spices are thought to contribute towards positive health outcomes in cases such as diabetes, cardiovascular disease and cancer. In addition, the starch hydrolase inhibitory property is a currently accepted mechanism of action for the controlled release of glucose, which is beneficial for those who have been contracted with ditbtes. Crucially, the results of this study showed that antioxidant capacity and starch hydrolase inhibitory activities are relatively stable throughout the digestive process in majority of the selected herbs and spices, suggesting that these food products may be a significant source of bioaccessible bioactive compounds. Additionally, this research work also highlights the importance of using multiple methods of analysis for the measurement of total antioxidant capacity (TAC) in the absence of any single ccepted assay. This is an important aspect which was highlighted, different importance, coffee is considered as one of the since TAC measurement can be carried out via dirfferent methodologies, all of which assess the ability of food material to inhibit the progression of various radica sources via different pathways. Although cell culture- based, animal-based, or clinical trial-based studies are able to provide more conclusive evidence, the *in vitro* digestion model used in this study could be used as a preliminary screening step prior to embarking on study models which require much more resources and planning.

M.Phil. Students	**:**	Ms. Mindani I. Watawana, Ms. Nilakshi J ayawardena, Ms. Chaminie B. Gunawardhana (NRC)
Volunteer Research Students	**:**	Ms. Ruchini T. Jayathilaka, Mr. Shakkya J. Ranasinghe, Ms. Pavithra N. Herath
Key Publications	**:**	

(1) Watawana MI, Jayawardena N, Waisundara VY (2015). Evaluation of the antioxidant activity,
polyphenol contents and starch hydrolase inhibitory activities of coffee drinks fermented with Kombucha 'Tea Fungus'. *J. Food Proc. Pres.* 39, 2596–2603.

(2) Waisundara VY, Watawana MI, Jayawardena N (2015). *Costusspeciosus* and *Cocciniagrandis*: Traditional medicinal remedies for diabetes (Mini Review). *South Afr. J. Bot.* 98, 1– 5.

(3) Lee YH, Choo C, Watawana MI, Jayawardena N, Waisundara VY (2015).

Evaluation of the total antioxidant capacity & antioxidant compounds of different solvent extracts of Chilgoza pine nuts (*Pinus gerardiana*). *J. Funct. Food.* 18, 1014–1021

From Left: Ms. PN Herath, Ms. MI Watawana, Dr. VY Waisundara, Ms. N Jayawardena, Mr. SJ Ranasinghe, Ms. CB Gunawardhana

Gamini Seneviratne

Research Professor gaminis@ifs.ac.lk
+94 81 2232002
http://www.ifs.ac.lk/research_units/microbial_bio_technnology.php

Microbial Biotechnology

esearch program focuses on investigations of the role of developed microbial biofilms in agriculture, plantations and the environment. With the invention of development of microbial biofilms [fungal-bacterial biofilms (FBBs) in particular] in vitro in 2002, several basic research studies were conducted to evaluate their potential as microbial ameliorators in the soil and also in the environment. The studies yielded very promising results. Consequently, biofilm- based biofertilizers called Biofilm biofertilizers (BFBFs) were developed for agriculture and plantation crops (especially non-legumes, e.g. tea, rice, vegetables etc.), tested extensively under field conditions, and were commercialized in 2014. At present, the BFBFs are also being tested as biofertilizers for tea cultivation in South India with very promising initial results.

It is a well-known fact that conventional agronomic practices, particularly chemical fertilizer (CF) application, deplete the diverse microbiome. Most of the disappeared biodiversity as a response to CF application enter into an inactive or dormant phase to bypass the unfavourable conditions, by forming ‘seeds’, which are stored in soil seed bank.The role of BFBFs is to reinstate sustainability of degraded agroecosystems through breaking dormancy of the soil microbial seed bank, and in turn restoring microbial diversity and ecosystem functioning. Wider array of biochemicals secreted by the biofilms against mono or mixed microbial cultures with no biofilm formation is the key for the dormancy breaking. The biofilm applications for heavy metal (e.g. chromium) removal from contaminated sites have also been developed.

Current studies are centered around, 1) basic research investigations on microbial biofilm mediated dormancy breaking of soil microbial seed bank, 2) developing quality parameters for BFBFs based on crop response, 3) microbial biofilm induced carbofuran biodegradation, and 4) evaluating BFBFs for diverse agricultural, plantation and floricultural crops.

Soil ecosystem deteriorates due to natural and anthropogenic disturbances, which interrupt the ecosystem functions and sustainability. As a consequence of this retarded soil system, a part of plant and microbial diversity becomes dormant, making a seed bank, which poses a major threat to the below and above ground diversity. In order to address above issue, a basic study was conducted to investigate the potential of a developed FBB against bacteria alone that are in the FBB, in resuscitating the soil seed bank. The results showed that there is a significantly higher possibility of using FBBs over bacteria alone to break the dormancy of soil bacterial seed bank for enhanced biodiversity (Figure 1). Further, the bacteria emerged from the dormancy breaking with the treatment of the FBB formed a separate cluster in the FTIR based dendrogram, indicating that the biofilm action has tended to break dormancy of a group of soil bacteria that are unculturable (Fig. 2). This study has very important implications in culturing yet-unculturable bacteria.

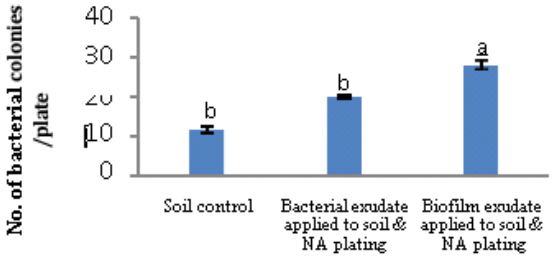


Figure 1. Number of bacterial colonies appeared after 7days incubation of soils treated with bacterial and fungal- bacterial biofilm (FBB) exudates

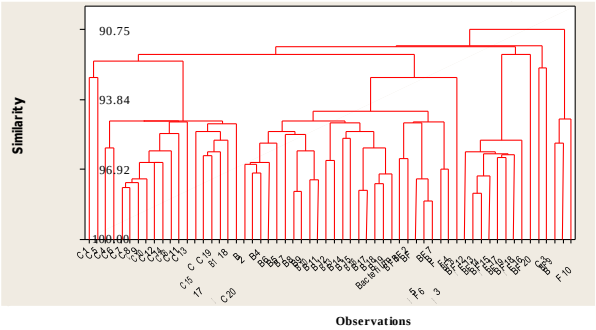


Figure 2. FTIR based dendrogram of bacteria isolated from microbial treatments after 7 days of soil incubation.

Quality of biofertilizers is one of the most important factors. Quality of the product results in their success or failure, and it also determines the acceptance or rejection by the farmer. The most important qualitative factor is crop response or yield. Relationship between quality parameters and the yield can be used to predict the yield response of a crop to a biofertilizer. A study consisting of both laboratory analyzes of biofertilizer and their field evaluations for crop response was conducted using Biofilm-T, the biofilm biofertilizer used for tea cultivation. Results showed that laboratory parameters of Biofilm-T, i.e. bacterial colony forming units (CFUs)

after 24 hours in nutrient agar plates (NA24), CFUs after 48 hours in combined carbon medium plates (CCM48), sum of peaks of SH region (thiol compounds), sum of peaks of amide compounds (AM) and seedling length **average (SL)** were the factors which predicted tea yield in in the fielf.

Tea yield= 6.29 + 0.09[*CCM48*]- *9.8*[SH] – 0.06[NA24] + 3.44[AM] + 1.03[SL] (R^2=0.83 P<0.01) Futher, it was found that Biofilm-T performs better the recommended chemical fertilizer practice of tea cultivation (i.e. 100% CF), if we apply the biofertilizer manufactured 4-14 months before (Figure 3). Thus, the expiry date of Biofilm-T can be extended up to 14 months.

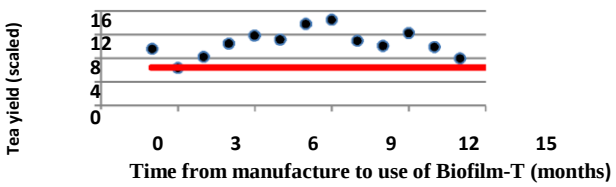


Figure 3. Tea yield response to different batches of Biofilm-T manufactured in different times.

The bacterial biofilm showed the highest Carbofuran degradation compared to the other treatments (Table 1). This study indicates that microbial biofilms can be used as a potential bioremediation technique to remove problematic chemical compounds from the environment. Further studies are however needed to examine full potential of this technology.

Carbofuran is one of the powerful and massively used carbamate pesicides which are used to control insects in a wide variety of field crops. As a result of its widespread use, Carbofuran has been detected in ground, surface and rain waters, in soils, air, foods and wildlife. Therefore, the degradation process of Carbofuran is very important to maintain the balance of the ecosystem and their sustainability. Degradation of Carbofurans is usually a combination of a number of processes, including chemical hydrolysis and microbial degradation. In soils, biodegradation of Carbofuran is activated by bacterial populations, particularly in biofilm mode. Thus, a study was conducted to evaluate the effect of developed microbial biofilms on Carbofuran degradation. One bacterial biofilm, one fungal biofilm and a fungal- bacterial biofilm (FBB) based on the bacterium and the fungus were used as treatments

The bacterial biofilm showed the highest Carbofuran degradation compared to the other treatments (Table 1). This study indicates that microbial biofilms can be used as a potential bioremediation technique to remove problematic chemical compounds from the environment. Further studies are however needed to examine full potential of this technology.

Table 1. Carbofuran degradation in different treatments

Treatment	Carbofuran (%)
Bacterial biofilm	68
Fungal-bacterial biofilm	47
Fungal biofilm	40
Control	11

Foliage plants are an important sector in Sri Lanka, because they earn 90% out of total floriculture industry trade. *Draceana sanderiana* and *Cordyline fruticosa* have a high demand among the cut foliages. Due to perishable nature in foliages they are highly susceptible to pest and pathogens which cause loss of appearance and thereby reduce the ornamental value of the plants. Tip burning, leaf spots, Fusarium stem and root rot are some of the major diseases in these plants. Thus, a study was conducted to identify the possibility of the using Biofilm- F, the Biofilm biofertilizer developed for floriculture, in order to control the diseases of *D. sanderiana* "white", *D. sanderiana* "gold" and *C. fruticosa*. It was found that the Biofilm-F applied with half strength CF was more effective than full strength CF to reduce the diseases by up to 35% of the two foliages, while promoting plant growth.

M.Sc./M.Phil Students: P. Wijepala, S. Gunaratne
Ph.D. Students: A. Hemagamage, D. Sinhalage, R.D.A. Gunasekara

Key publications

1) Seneviratne G, Jayasekara APDA, De Silva MSDL, Abeysekera UP (2011). Developed microbial biofilms can restore deteriorated conventional agricultural soils, *Soil Biol. Biochem*., 43, 1059-1062.

2) Seneviratne G, Kulasooriya SA (2013). Reinstating soil microbial diversity in agroecosystems: The need of the hourfor sustainability and health. *Agric. Ecosyst. Environ*., 164, 181-182.

3) Herath HMLI, Rajapaksha AU, Vithanage M, Seneviratne G (2014). Developed fungal-bacterial biofilms as a novel tool for bioremoval of hexavelant chromium from wastewater. *Chem. Ecol*., 30, 418-427.

From Left: Ms. HKSNS Gunaratne, Ms. RKK Karunaratne, Mr. AK Pathirana, Prof. G Seneviratne, Ms. PC Wijepala, Ms. K Dissanayake, Ms. MM Wijeweera

Lalith Jayasinghe

Research Professor
ulbj2003@yahoo.com
+94-812232002

Natural roducts

Natural Products are compounds produced by plants, fungi marine organism etc. These compounds can be used to improve the quality of human life. The use of natural products in the management and treatment of diseases in humans and plants is more acceptable and offers less risk than use of synthetic compounds.

The overall objective of the Natural Products Project of the NIFS is the identification of bioactive extracts and compounds from natural sources, as potential resources for control of human and plant diseases. Research activities in the Natural Product Project 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).

In our studies, the bioactivities of extracts and compounds are assessed using bioassays; [DPPH (2,2’-diphenyl-1- picrylhydrazyl) radical scavenging assay to detect the presence of natural antioxidants; the brine shrimp (*Artemia salina*) lethality assay to detect cytotoxicity; the lettuce (*Lactuca sativa*) seed germination assay to detect the presence of phytotoxic and allelopathic compounds, the TLC bioautography method to detect the presence of antifungal compounds, □-amylase, □-glucosidase and lipase inhibitory activity assays to detect drug targets for the treatment of diabetes, obesity and hyperlipidemia. Bioactive extracts are subjected to activity guided fractionation using chromatographic techniques to isolate bioactive compounds. Structures of isolates are determined by detail ed analysis NMR, MS spectral data. Partial syntheses of isolates are carried out to enhance the bioactivity of isolates.

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

(1) Exploitation of extracts from plant sources and common fungal pathogens for use in agriculture and human health
(2) Chemistry and Bioactivity of edible fruits
(3) Plant secondary metabolites and LC-MS profiling of bioactive extracts

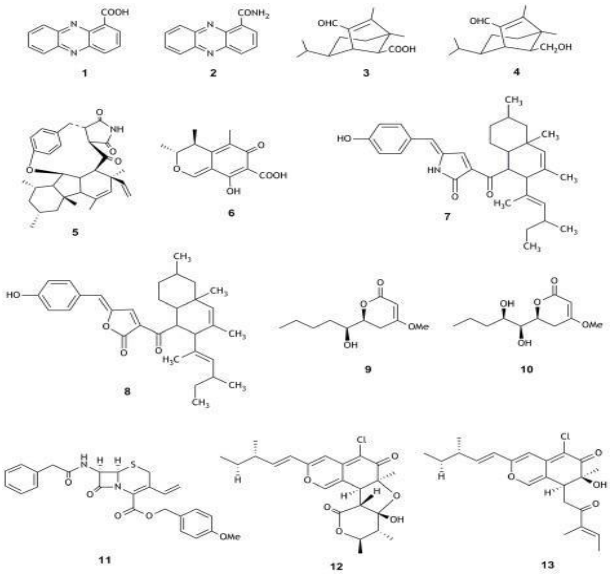
Chemistry and bioactivity of fungi associated with medicinal plants and edible fruits.

Fungi can be mainly categorized as endophytic and epiphytic fungi. Endophytes are found in the inner tissues or even in the cells of their host while epiphytic fungi grow on the surface of the host. Endophytes are considered to be a rich source of secondary metabolites with novel structures and interesting bioactivities. These metabolites have found extensive applications as agrochemicals, antibiotics, immune suppressants, antiparasitic and anticancer agents. Some endophytic fungal strains produce natural products that are either identical or closely related to those produced by the host plant. A well-known example is the production of Taxol, an anti-cancer drug obtained from the Pacific Yew tree *Taxus brevifolia*, which was also produced by the endophytic fungus *Taxomyces andreanae* isolated from the bark of *T. brevifolia*. Recently we have studied the chemistry and bioactivity of secondary metabolites produced by the endophytic fungi isolated from some medicinal plants – *Amaranthus viridis* (Koora Thampala), *Camellia sinensis* (Tea), *Coccinagrandis* (Kowakka), *Costus speciosus* (Thebu), *Passiflora edulis* (Passion fruits), *Piper nigrum* (Gammiris) and some endophytic fungi isolated from some popular edible fruits *Artocarpus altilis* (Del), *Averrhoa carambola* (Kamaranga), *Carica papaya* (Papol), *Flacourtia inermis* (Lovi), *Garcinia mangaostana* (Mangostin), *Manilkara zapota* (Sapodilla), *Musa* sp. (Banana), *Pouteria campechiana* (Lavulu) and *Syzygium samarangenes* (Jambu). Several secondary metabolites with interesting structural features and some useful bioactivities were isolated. Structures of some selected compounds are; Phenazine-1-carboxylic (**1**) & phenazine- 1-carboxamide (**2**) {from *Nigrospora oryzae* from *C. grandis*}; helminthosporal acid (**3**) and helminthosporol (**4**) {from *Bipolaris sorokiana – C.speciosus*}, GKK1032B (**5**) and citrinin (6) {*Penicillium citrinum* from *G. mangostana*); Taloroconvolutin A (**7**) and its furanone analogue (**8**) {from *Fusarium purpurogenum* from *P. campechiana*); pestalotin (**9**) and hydroxypestalotin (**10**){*from M. zapota*}, Cephem derivative (**11**) (from *Aspergillus awamori* from *Musa* sp.}; Chaetomugilin A (**12**) and Chaetomugilin J (**13**) {from *Chaetomium globosum* from *A. viridis*).

Profiling of some medicinal plants and edible fruits

The major bioactive groups of compounds in dietary plants are polyphenols. Phenolic acids, such as chlorogenic acids, phenolic glycosides, proanthocyanidins and saponins have been reported to be present in some of the herbs consumed by people. Most of the dietary plants have physiologically active components with a health enhancing role. Polyphenols are receiving more attention from scientists due to their beneficial effects as antioxidants, anticancer, cardio protective, antimicrobial, antiaging, anti-inflammatory agents etc. Several epidemiological studies suggested that regular consumption of food and beverages rich in polyphenols is associated with a reduction in the risk of a range of pathological conditions ranging from hypertension to coronary heart disease, stroke and dementia. Chlorogenic acids (CGAs) are the most important single class of dietary polyphenols. By definition, chlorogenic acids are esters of quinic acid, most commonly characterized by

hydroxycinnamate ester moieties. CGAs display a wide range of fascinating biological activities including anti-HIV, anti-viral, anti-plasmodic, inhibit glucose transporters or show opioid receptor activity. Since a majority of the Asian population consumed a large number of dietary medicinal plants it is important to profile the chemical constituents in these plants.



LC-MS is a powerful technique to analyze chemical constituents present in a mixture. Structures of the chemical constituents are generally identified on the basis of their retention times and mass fragmentation pattern by LC-MS studies. Recently, we have identified a series of phenolic compounds from the fruit extract of *Flacourtia indica* (Ugressa) and *Flacourtia inermis* (Lovi), which were investigated qualitatively by HPLC tandem mass spectrometry and high resolution mass spectrometry. Thirty-five phenolic compounds were detected and characterized on the basis of their unique fragmentation pattern in the negative ion mode tandem MS spectra. Twelve were extracted for the first time from these sources and four have not been reported previously in nature. It was also possible to distinguish between the isobaric (same molecular weight) phenolic compounds dicaffeoylquinic acids and caffeoylquinic acid glycosides. For the positive identification of phenolic compounds by LC-MS^n, a series of experiments were carried out. This was the first report for the full characterization of phenolic compounds of the fruits of *F. indica* and *F. inermis* by LC-MS^n.

Edible fruits as a source of Bioactive Compounds

Fruits have been consumed for centuries by animals and humans and are reliable source of non-toxic and environmentally friendly bioactive compounds. Most of the studies on edible fruits are limited only to their nutritive value. Consumption of fruits has been associated with a reduced risk of chronic diseases and the reduction of functional declination associated with aging. Bioactivity studies of compounds specific to tropical fruit plants have led to the discovery of new chemical entities with interesting bioactivities and reduced toxicity. The presence of inhibitors of carbohydrate hydrolyzing enzymes eg. α-amylase, α- glucosidase in plant derived foods is of immense importance in the control of blood glucose level in patients with type-II diabetes.

Antioxidants help to prevent free radical induced oxidative stress and also to either prevent or delay diseases related with aging. Fruit extract that display antifungal activity could lead to the isolation and identification of environmentally friendly pesticides and antifungal agents. Our recent studies led to the identification of some antifungal, phytotoxic and antioxidant active compounds from *Aegle marmelos* (Beli) and some phytotoxic compounds from the fruits of *Averrhoae carambola* (star fruit).

M.Phil. students : Ms. CL Kehelpannala, Mr. GRN Rathnayake, Ms. D Thanabalasingam, Mr. MM Qader, Ms. DMDM Dissanayake, Ms. T Sritharan (NRC), Ms MV Kanthi (NSF)

Post doc : Dr. HMDK Kanatiwela (NSF)

Key Publications

1) Bandara HMSKH, Kumar NS, Jayasinghe L, Masubuti H, Fujimoto Y (2015). A 3-vinyl cephem derivative, useful intermediate in the synthesis of cephem antibiotics, from *Aspergillusawamori* associated with banana fruit, *Natural Product Communications*, 10, 1663-1666.

2) Thanabalasingam D, Kumar NS, Jayasinghe L, Fujimoto Y (2015). Endophytic fungus *Nigrospora oryzae* from a medicinal plant *Coccinia grandis*, a high yielding new source of phenazine-1- carboxamide, *Natural Product Communications*, 10, 1659-1660.

3) Alakolanga AGAW, Siriwardane AMDA, Kumar NS, Jayasinghe L**,** Jaiswal R, Kuhnert N (2014). LC-MS^n identification and characterization of the phenolic compounds from the fruits of *Flacourtia indica*(Burn.F.) Merr. and *Flacourtia inermis* Roxb. *Food Research International*, **62**, 388-396

From Left: Mr. MM Qader, Mr DS Jayaweera, Ms. D Thanabalasingam, Prof. L Jayasinghe, Prof. NS Kumar, Mr. GGM Wimalasena, Mr. GRN Rathnayake, Ms. MV Kanthi, Ms. DMDM Dissanayake

Ruvini Liyanage

Research Fellow
ruvini@ifs.ac.lk
+94 812 232 002
http://www.ifs.ac.lk/research_units/food_science.php#fac

Nutritional Biochemistry

Nutritional Biochemistry project focuses on various aspects of functional and nutritional properties of foods and covers a wide area like functional and nutritional properties of food, bioavailability of food, food safety, novel method development, functional food product development, and nutritional surveys.

Functional and nutritional properties of food: Under this research theme, studies are done to assess the antioxidant, enzyme inhibition (amylase, glucosidase, lipase), radical induced DNA damage prevention and identification of active compounds. In addition, *in vivo* studies are also done for further confirmation of functional properties.

Novel assay development: A novel assay was developed to determine α-amylase activity. α-Amylase is an enzyme responsible for hydrolysing α bonds in such as starch and glycogen, yielding glucose and maltose. Although there are several methods to determine α-amylase activity, the novel method is more convenient, less costly, and less laborious.

Food Safety: Heavy metals are trace elements that cause negative impacts on human health, even at very low concentrations. In this study Heavy metal concentration in broiler tissues and broiler feed were analyzed.

Functional Food Product Development: Under this two novel functional food products were developed. *Moringa* leaf powder incorporated soy drink was developed as a substitute for cow milk and Avacado incorporated butter was developed to increase the Monounsaturated (MUFA) and Polyunsaturated (PUFA) fats in conventional butter.

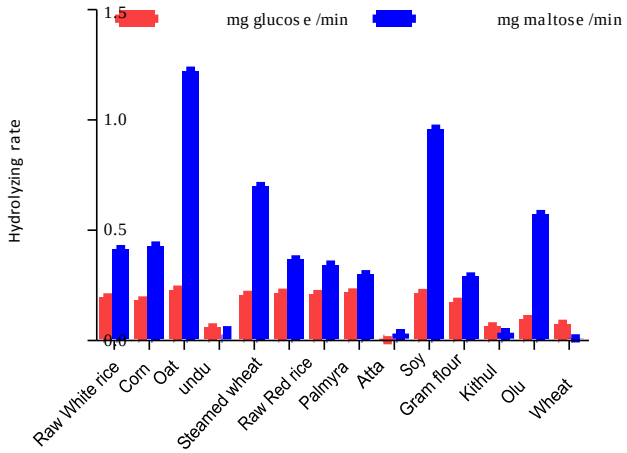
Functional properties of foods:

Recently, the interest in medicinal plant usage for treating several disease conditions has increased due to exerted beneficial properties such as antioxidant, anticancer, hypoglycaemic and hypolipidaemic activities. Therefore, a study was conducted to assess the *in vitro* functional properties of hot water extracts of 10 commonly used medicinal plants in Sri Lanka. Among the tested plants, the Nelli extract was found to exert extremely high antioxidant and amylase inhibitory activities

Samples of dried medicinal plants

As one possible way to overcome diabetes, a great interest has been stimulated in understanding the relationship between different types of dietary carbohydrates and appetite regulation. Starch is one of the main energy sources in Sri Lankan diet. Thus, the hydrolyzing rate of fourteen different types of available flours was assessed against the enzymes α-amylase and amyloglucosidase. According to the results, soy, oat, Olu, chick pea, Kithul, Undu and Palmyra starches showed slower digestibility compared to the commonly used flours wheat, Atta, raw white rice, kurakkan, raw red rice and steamed wheat.

Starch Hydrolyzing Activity by Amylase and Amyloglucosidase



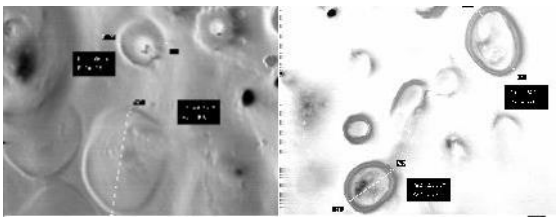
To better understand the bioavailability of these functional compounds a study was conducted to assess the antioxidant and prebiotic activity of undigested and digested jackfruit seeds and jackfruit bulbs by mimicking natural digestion process using swine stomach and intestinal juice. Results showed a significant increase in

antioxidant and prebiotic activity after *in vitro* digestion of mature jackfruit seeds and bulbs. These insights are of significance for pinpointing the beneficial properties of naturally available food sources and in the context of selection of these commodities in food processing, agriculture and medicine. On pharmacological grounds identification of the functional properties of active compounds paves the way for the development of natural remedies for treating diseases.

Novel assay development: There are numerous methods used for the determination of α-amylase activity among which the DNSA assay, that measures the reducing power of a solution is the most widely used method. However, these methods share common problems, being labor intensive, time consuming and costly when the number of the samples is large, as is the case with herbal plants. Therefore, our research group developed an easy, microplate based assay method for the determination of the α-amylase inhibitory activity of plant compounds. As compared to the DNSA method, the new method is more convenient for kinetic studies where the reagents and plant extracts are put into the microplate and the readings are taken at once.

Food Safety: Heavy metals are incorporated into poultry feed as a supplementary diet, to fulfill protein requirement and as a mineral supplements. Thus in this study the heavy metal concentration in broiler tissues and broiler feed was analyzed. From the results it was found that heavy metal concentration in some poultry tissues were higher than the permissible level determined by WHO. As the results were alarming more comprehensive study will be conducted in the future.

Functional Food Product Development:
There has been an explosion of consumer interest in the health enhancing functional foods at present. In our research group with the collaboration of Department of Animal Science, Faculty of Agriculture, University of Peradeniya, we developed two novel functional foods; as Avocado Incorporated Butter and *Moringa* leaf powder incorporated soy drink with various health benefits. Consumer acceptability for both products was satisfactory and biochemical analysis confirmed the presence of expected physico chemical properties.



SEM images of conventional (left) and Avacado incorporated butter (right)

Nutritional Surveys:

The ultimate objective of this study was to develop household food security models to ensure nutritional security and food safety in poverty strickenVV X Sri Lanka. This study was restricted to poverty stricken two DS Divisions in Kandy and Matale. According nutritional survey only 26.9% of children in Ududumbara and Minipe DS divisions in Kandy had satisfactory nutritional status and 73.1% had some form of malnutrition.

In Ambangaga and Yatawatta DS divisions in Matale district (n=26), only 11.6% had satisfactory nutritional status and 88.5% had some form of malnutrition. It is therefore, almost important to ensure nutritional security through the intended home garden model

M.Sc./M.Phil Students: Oshini Perera, Chatuni Jayathilake, Rizlliya Visvanathan, Uditha Premarathne, Indeewari Ihalage

Key Publications

1) Liyanage R, Perera OS, Weththasinghe P, Jayawardana BC, Vidanarachchi JK, Sivakanesan R (2014). Nutritional properties and antioxidant content of commonly consumed cowpea cultivars in Sri Lanka**.** *Journal of Food Legumes***.** *27*,215-217.

2) Jayawardana BC, Liyanage R, Lalantha N, Iddamalgoda S, Weththasinghe P (2015). Antioxidant and antimicrobial activity of Drumstick (Moringaoleifera) leaves in herbal chicken sausages. *LWT - Food Science and Technology*64:204-1208.

From Left: Ms. I Thumpela, Ms. Hemanthi Kumari, Dr. R Liyanage, Ms. C Jayathilake, Ms. R Visvanathan, Ms. U Premarathne

M.C.M. Iqbal

Associate Research Professor
mcmif2003@yahoo.com
+94 812 232 002

Plant Biology

Our research interests are addressing issues related to our environment and how research conducted in the field and laboratory can provide solutions. The project on Forest Ecology is investigating the degradation of our forests, particularly the dry forests in the dry zone of Sri Lanka. Forest degradation is due to illegal activities such as chena cultivation, extraction of timber and non-timber forest products. To restore the forest as nearly as possible to their original status, it is necessary to quantify the degradation in terms of diversity of the plant sp ecies, and structure of the forest as well as changes to the nutrient quality of the soil. This research is being done in the Hurulu forest in the Pollanaruwa district, Nuwaragala forest in the Ampara district and our own forest arboretum in Dambulla.

The project on Environmental Remediation is concerned with pollution of waterways by heavy metals and textile dyes. These are discharged by Small and Medium scale industries. We are using the ability of plants to take up these pollutants – called phytoremediation – and also the use of biomass derived from plants to soak up metals and dyes. Certain aquatic plant species have the ability to absorb pollutants without causing any harm to the plants. Biomass derived from waste plant material can bind the pollutants depending on the oppositely charged ionic surface of the biomass and the pollutants.

Forest degradation and restoration

Although most studies on forest degradation and restoration have been done in rain forests, so far no comprehensive phyto-sociological studies linking sociological aspects and forest restoration has been done in the dry forests in Sri Lanka. It is apparent that the rising socio-economic impacts from development activities, human settlements, irrigation systems, agricultural projects, wild fires and alien invasive plants have extensively degraded dry forests in Sri Lanka. Therefore, forest restoration studies are urgently needed for the degraded dry forests. This research project is principally focused on phyto-sociological and human sociological variations associated with dry forests in two different Agro Ecological Regions in the dry zone: Hurulu and Nuwaragala forest reserves. The study has selected *Khaya senegalensis* (Desr.) A.Juss. and *Tectona grandis* L.f. plantation and NIFS Popham arboretum in the dry zone as other study sites in which restoration options has been already adopted. Plot experiments were conducted to assess phyto-sociology of Hurulu and Nuwaragala forest reserves with different forest degradation regimes and different restoration options. Socio ecology of local communities living in and around the above forest reserves will be assessed by using questionnaire survey. The key outcomes of this study will be significant to implement sustainable and efficient biodiversity conservation strategy in the dry zone of Sri Lanka.

Another study is being carried out in a recently discovered Moraella relict forest in the Kandy plateau in Sri Lanka. Rain forests in the Kandy plateau were heavily deforested and degraded in the mid-19th century for conversion to coffee, cinchona and tea plantations. Remaining relict forests also are highly degraded due to various anthropogenic activities, encroachment by alien invasive plants, forest fragmentation and isolation of climax forest. To date, very few phytosociological studies have been done on these forests. The objective of this study is to assess the phytosociology of Moraella forest and how effective this forest community is as a floristic diversity refugia in the Kandy plateau.

Extracting of soil samples

Bioremediation of heavy metals

Contamination of water bodies due to textile dyes and heavy metals create socio-economic problems and health problems to living organisms. These pollutants enter the environment mostly through wastewater discharge. Treatment of contaminated waste water is an expensive process where, expensive instruments and regular maintenance is required. Therefore Small and Medium scale Entrepreneurs (SME) are hesitant to adopt these methods. To prevent further decontamination of the water bodies' from these pollutants and to enable waste water treatment by SME, low-cost treatment methods should be introduced. Biosorption is a cost effective alternative method to treat waste water.

Biosorbent prepared from *Mimosa pigra* seed pods

In the biosorption technique, non-living plant materials are used to adsorb pollutants form the contaminated wastewater. Non-living biomaterials consist of hard woody structures such as primary and secondary cell walls. These structures are made out of biopolymers such as cellulose, hemicellulose and lignin. Functional groups present in these biopolymers readily form interactions with the pollutant present in the wastewater. These can be chemical or physical interactions. Depending on the interactions between the pollutant and the plant materials suitability of the plant material as an adsorbent will be decided. Interactions between the pollutant and the plant material depend on the external parameters of the environment. External parameters include pH of the system, duration of contact, shaking speed, rate of contact, pollutant concentration and amount of biosorbent.

To increase the efficiency of the biosorbent, simple modifications such as protonation of the biosorbent and grafting of chemical groups can be used. After determination of a suitable biosorbent and the external parameters the selected biosorbents will be used in fixed-bed column reactors to determine the fixed-bed column parameters which can used to design a large scale biosorbent system for use by SMEs.

Bioremediation of organic dyes

Addressing environmental pollution is one of a major concern since it adversely affects environmental, social and economic aspects. Environmental remediation is the removal of pollutants or contaminants from the water (both surface and ground water) and soil to ensure the protection of environmental and human health. Apart from the physico-chemical remediation techniques, the biological methods have a major role in terms of cost effectiveness, easy operation and eco-friendliness. In our project we are using two biological remediation methods: Phytoremediation and Bio-sorption. Phytoremediation is the removal of pollutants from water or soil by using live plants while bio-sorption stands for the removal of pollutants by using non-living biomass. Our research interests are focused on removing textile dyes and heavy metals from aqueous systems. Synthetic textile dyes are complex organic compounds and classified as carcinogenic, mutagenic and teratogenic. Owing to their high stability, dyes can persist charcoal for remediation has been practiced by several in a variety of environments and traverse through the food chains ending up with bioaccumulation and bio- ancient ivilizations including project we are focusing on Sri Lanka. Through this using biomass derived magnifications in living organisms. Hence, dyes can cause adverse health impacts on humans and animals. Color pollution of waterways also reduces photosynthesis by aquatic plants and microorganisms by preventing charcoal or "biochar" for the removal of textile dyes. Biochar derived from different waste materials such as sawdust and rice husk are using for remediation with different pyrolysing temperatures, as the feedstock and sunlight penetration through the water column.

Removal of textile dyes by using phytoremediation techniques

Phytoremediation has received increasing attention after the discovery of hyper-accumulating plants, which are able to accumulate, translocate, and concentrate high amounts of toxic heavy metals in their above-ground or harvestable parts. We are investigating aquatic plants that are easily available, tolerant and have a potential to absorb pollutants, for removing textile dyes from aqueous solution. Crystal violet dye is a model

basic dye and is widely used in a variety of industries including textile industry. We have used water lettuce (*Pistia* approach. We have used Gliricidia woody biochar and Lunumidella (*Melia azedarach* L.) sawdust biochar derived at three different temperatures, 300 °C, 500 °C and 700 °C, to investigate their potential for removal of crystal violet.

Experiments were conducted to determine the optimal conditions for the dye dye uptake process such as plant bomass, contact time, solution PH, and and dye concentrations. And also fothe maximum uptake capacity. These findings can be used in industiries for planning treatment of effiuent water such as small and medium scale construction of wetlands. Our resuts showed that water Lettuce and salvinia, have a good potential to remover the crstal violet dye within a short contact period of 48 hours.

Removal of textile dyes by using Biochar

The term "biochar" refers to the biomass derived charcoal which are subjected to physical modification through the high temperature pyrolysis process. Using charcoal for remediation has been practiced by several ancient civilizations including project we are focusing on Sri Lanka. Through this using biomass derived charcoal or "biochar" for the removal of textile dyes. Biochar derived from different waste materials such as sawdust and rice husk are using for remediation with different pyrolysing temperatures, as the feedstock and pyrolysing temperature plays a key role in changing sorption properties. Experiments were conducted to determine the optimal operational parameters for the sorption process such as biochar dosage, solution pH, contact time and dye concentrations.

Apart from the basic experiments, we have predicted the fate of the dye and possible physical and chemicalmechanisms through a mathematical modeling approach. We have used Gliricidia woody biochar and Lunumidella (*Melia azedarach* L.) sawdust biochar derived at three different temperatures, 300 °C, 500 °C and 700 °C, to investigate their potential for removal of crystal violet dye. Results showed that the sorption capacities increased with the elevation of the pyrolysis temperature and the optimal dye adsorption was at a higher solution PH.

M.Phil students : LRC Premalal, WT Awanthi, WMKEH Wijesinghe

Ph.D students : WWMBA Medawatte, DMREA Dissanayake

Key Publications **:** Dissanayake DMREA, Wijesinghe WMKEH, Iqbal SS, Priyantha

HMDN and Iqbal MCM. (2015). Isotherm and kinetic study on Ni(II) and Pb(II) biosorption by the fern *Aspleniumnidus* L.. Ecological

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From Left: Mr WWMAB Medawatte, Mr. RB Happukotuwa, Mr. JW Anukulan, Mr. DMREA Dissanayake, Prof. MCM Iqbal, Ms. WT Awanthi, Ms. LRC Premalal, Ms.WMKEH Wijesinghe, Ms. HPGRM Samarakkody, Ms. RMS Perera

S.A. Kulasooriya

Visiting Research Professor

+94 812 232 002

Biological Nitrogen Fixation

Biological nitrogen fixation (BNF) is the conversion of inert atmospheric dinitrogen (N_2) to a combined form by living organisms catalyzed by the enzyme nitrogenase. It is a process confined to certain prokaryotic, aerobic, micro -aerobic or anaerobic microorganisms which can be free-living, associative and symbiotic. Nearly 65% of the atmospheric nitrogen enters the global nitrogen cycle through BNF. This natural process has been studied since its discovery in 1888 in order to understand the process and utilize it as a natural resource for agriculture and forestry.

The BNF Project at the IFS commenced in 1983 and basic studies were conducted on nitrogen fixation by free living and symbiotic cyanobacteria and their possible utilization in rice cultivation, associative nitrogen fixation and its utilization in wetland and upland cereal and sugarcane production and symbiotic nitrogen fixation with leguminous plants. The project received a boost when the Katholiek University of Leuven (KUL), Belgium became a collaborative partner in 1991 with significant funding coming from them.

A landmark finding from these studies was the development of a coir dust based carrier for rhizobial inoculants. This carrier material has been used ever since and currently these inoculants are applied to 10,000 acres of soybean without the application of any urea fertilizer. Recent studies with such inoculants have given very promising results for vegetable beans, mung bean, cowpea and the forage legume white clover and further work is in progress with ground nut and black gram. The widespread use of such inoculants could significantly reduce the application of environmentally detrimental chemical N-fertilizers.

Key ublications

Efficient use of sustainable biological nutrient management systems (Ed Ir. L. Van Holm Res Report 1991 – 1995, IFS- KUL BNF Project: 168p) and *Sesbaniarostrata*, A Potential Green Manure for Lowland Rice 1996 Ed Ir. L. Van Holm IFS - KUL BNF Project: 130p).

Savitri Kumar

Visiting Professor
nskumar3@gmail.com
+94777576304

Natural Products

Edible fruits of Sri Lanka, a source of biologically active secondary metabolites
Flacourtia inermis (Sinh.Lovi), an under - exploited fruit, was found to be a good source health promoting anthocyanins and phenolics including chlorogenic acids. Antioxidant activity, α-amylase and α - glucosidase inhibitory activities (anti- diabetic activities) displayed by Lovi fruit extracts indicates a possible use of these fruits in food supplements. LC-MS was used to identify and establish the structures of 35 phenolic compounds in Lovi fruit extracts.

Separation and characterization of fungal metabolites
Monacrosporium ambrosium (ambrosia fungus), the ectosymbiote of shot-hole borer (SHB) beetle, an insect pest in tea plantations of Sri Lanka, produced fungicidal napthoquinones in fungal culture media. Isolation, identification and biological properties of five naphthoquinones have revealed a new aspect of the symbiotic association between SHB and the ambrosia fungus.

Common fungal pathogens for use in agriculture

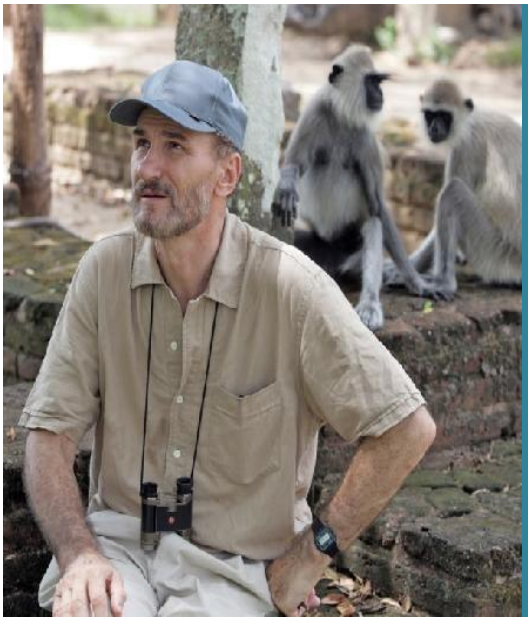
An endophytic fungus *Chaetomomium globosum*, was isolated from *Amaranthus viridis*, an allelopathic plant. Fungal cultures of *C. globosum* yielded two compounds with phytotoxic activity and which have a potential use as environmental friendly herbicides.

Key ublications

Alakolanga AGAW, Kumar NS, Jayasinghe L, Fujimoto Y (2015). Antioxidant property and α-glucosidase, α-amylase and lipase inhibiting activities of *Flacourtia inermis* fruits: characterization of malic acid as an inhibitor of the enzymes, Journal of Food Science and Technology, 52, 8383-8388.

Kumar NS, Bandara BMR, Hettihewa SK (2015). Isolation of a tetramericA-type proanthocyanidin containing fraction from fresh tea (*Camellia sinensis*) leaves using High Speed Counter-Current Chromatography, J. LiqChromatogr. Rel. Tech.38 1571- 1575

Piyasena KGNP, Wickramarachchi WART, Kumar NS, Jayasinghe L, Fujimoto Y (2015). Two phytotoxic azaphilone derivatives from *Chaetomium globosum*, a fungal endophyte isolated from *Amarathus viridis* leaves. Mycology, 6, 158-160.



Wolfgang Dittus

Visitin g Scientist wdittus@gmail.co
+94(0)777 282 700
www.primates.

Primate iology

The program involves observational studies of monkeys (primates) in their natural forest habitats. Our aims are: (1) to contribute new knowledge to the understanding of the evolution of social behaviour 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. Such popular media serve not only to educate and entertain, but also to gain public support for conservation in the local and international communities. Our films (e.g., 2015, Di sney Nature "Monkey Kingdom") also contribute positively to the image of Sri Lanka as a tourist destination.

Our scientific work has been buttressed by studies in population genetics, paternity exclusion, anatomy, epidemiology and physiology as they relate to the behavior, ecology and vital statistics of wild monkeys. Multidisciplinary data are fundamental for testing hypotheses regarding many sociobiological phenomena and the evolution of primate society. In practice, at our study site at Polonnaruwa (Sri Lanka), we have identified several thousand individual monkeys.For each macaque (*Macca sinicasinica* Linnaeus, 1771), we have traced its behavioural, genealogical, ecological and demographic history. Our methods are similar to those of actuaries; linking variables of behaviour and environment to those of survival. To this end, we require large samples over extended periods of time to assure statistical soundness (longevity in wild monkeys may exceed 35 years). Some time ago we have begun similar investigations of the gray [*Semnopithecus priamthersiites* (Blyth, 1848)] and purple-faced langur [*Semnopithecus vetulusphilbricki* (Phillips, 1927)] at our research site at Polonnaruwa. New studies focus as well on the slender loris (*Loris lydekkerianusnordicus* Hll, 1933).

Key ublications

1. Dittus W. (2013). Arboreal Adaptations of Body Fat in Wild Toque Macaques (Macacasinica) and the Evolution ofAdiposity in Primates. American Journal of Physical Anthropology, 152,333–44.DOI: 10.1002/ajpa.22351
2. Dittus W, (2013). Subspecies of Sri Lankan Mammals as Units of Biodiversity Conservation, with Special Reference to the Primates, Ceylon Journal of Science (Bio. Sci.), 42(2), 1-27.DOI: http://dx.doi.org/10.4038/cjsbs.v42i2.6606
3. Goto K, Fukuda K, Senda A, Saito T, Kimura K, Glander K, Hinde K, Dittus,W, et al., (2010). Chemicalcharacterization of oligosaccharides in the milk of six species of New and Old World monkeys, Glycoconugate Journal, 27:703–15. DOI 10.1007/s10719-010-9315-0

Primate Project staff
Mr. Sunil Gunathilake; Mr. Chameera Pathirathne, Mr. Sunil Rathnayake

Meththika Vithanage

nior Research Fellow eththikavithanage@gmail.com
4 812232002 / +94 750279477 tp
http//www.ifs.ac.lk/research_units/cesm.php

Chemical & Environmental Systems Modeling

Our research group is engaged in monitoring, research and modeling of water and soil systems that provides scientific support for restoration and management. Monitoring tells us what is happening, laboratory and field research tells why something is happening, and modeling helps to tell us what can happen. Soil and water pollution is common everywhere in the world due to excessive use of agrochemicals, antibiotics, polycyclic aromatic hydrocarbons, heavy metals, and metalloids, which are released to the environment from both non-point and point sources. Monitoring is essential to understand the fundamental mechanisms behind the release or removal in order to formulate a better remediation technique and/or a mitigation strategy. To accomplish this, our group is carrying out laboratory and field experiments on toxic metal release from soil and water, their removal using low cost materials such as biochar and nano-materials, and modeling pollutant plume dynamics.

Biochar has become a widely researched material as a soil conditioner for Carbon sequestration and soil quality improvement since none of the typical treatment materials was effective in both. Previously, we examined the potential of biochars produced from waste materials including municipal solid waste, agricultural waste, day-to-day waste generated from households and invasive plants to remove heavy metals, metalloids, antibiotics in water and soil systems, and results showed a high capacity for removal of several pollutants. Since 2012, our research group extensively worked in the field of Biochar for environmental remediation and we are one of the top 5 leading research groups in the world in terms of biochar publications. Our outputs are publications in high impact journals with high citations, patents, collaborative researches, finantial support through grants and postgraduate degrees. Our new approach is to investigate the potential of smart biochars as a universal material for water and wastewater remediation as well as restoration of contaminated soils and predict their mechanisms of removal through modeling.

In addition, our group is carrying out projects on (a) pollution monitoring of wastewater in particular from hospitals and municipal solid waste dump sites for assessing their quality, (b) synthesizing nano composites to integrate with environmental remediation processes, and (c) monitoring of atmospheric deposition for heavy metals and hydrocarbons and model their effect on human and ecological health.

programs have been criticized as they cost high while delivering less however, environmental monitoring serves a vital scientific role by revealing trends that can lead to new knowledge, understanding of the system, and that is essential for environmental planning, policy and to provide solutions. Our research group is monitoring groundwater, landfill leachates from Gohagoda Municipal Solid Waste (MSW) dumpsites and hospital wastewater (HWW), which may be useful for environmental planning and policy making. To accomplish this, our research group is facilitated with many different analytical instruments such as, UV-Visible Spectrophotometer, Atomic Absorption Spectrophotometer, Gas chromatography-Mass spectrometry, Ion chromatography, Total organic carbon analyzer, multiparameter etc. Monitoring data reveal that the landfill leachate which is directly flows to the River Mahaweli is highly polluted with various pollutants with high concentrations including many volatile organic compounds, heavy metals, nutrients, organic carbons etc (Figure 1).

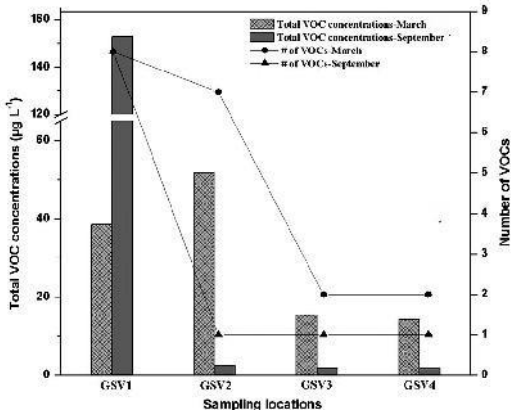


Figure 1. Presence of volatile organic compounds in landfill leachate from Gohagoda MSW dumpsite.

Perchlorate Research study was started in 2014. Perchlorate is an emerging contaminant in the earth as well as on Martian regolith. Currently, the role of perchlorate ion in different soil types in Mars regolith or in earth has not been systematically or experimentally investigated. This emphasizes the importance of modeling the potential of perchlorate interactions in soil as an environmental hazard on metal mobilization as well as its capability of destroying/removing organics in regolith. The objectives of this study include modeling of perchlorate on metals and organics using model regoliths such as serpentine soils and basaltic soils. Further, this study assesses the effect of perchlorate on soil carbon fractions, propose potential mechanisms of interaction and investigate amendments for perchlorate neutralization. The results illustrate that perchlorate, even at low concentrations, can both accelerate metal release and increase the bioavailable metal fractions in soils and regolith.

Biochar Research
has gained immense attention recently due to its universal potential for remediation of soil and water from various pollutants whilst acting as a material that improves soil quality. Our previous research showed that the biochar (BC) produced from waste materials are highly capable of removing heavy metals, metalloids as well as antibiotics. Our recent attempt was focused on pesticide removal and improve soil quality by immobilizing pollutants using biochars generated as a byproduct from the dendro

power industry. Simultaneously, we are researching on producing municipal solid waste biochar in order to test it potential to be used as a liner and capping material in landfill management to reduce the pollution from municipal solid waste dump sites. We conduct characterization, pot, incubation, batch, column experiments, modeling and spectroscopic techniques (Figure 2). Our future task is to produce engineered smart biochars with high capacity and capability in environmental remediation.

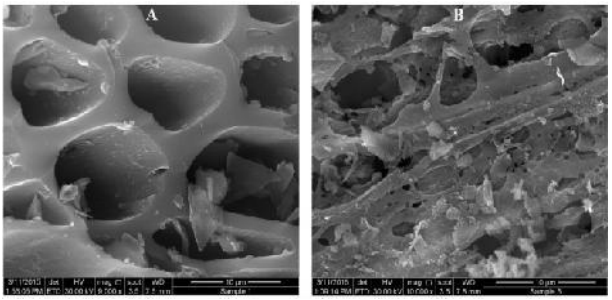


Figure 2. SEM images of steam activated Rice Husk BC (RHBC) (left) and non-activated RHBC (right).

Nano materials

have been widely used for environmental applications. Our research group has previously produced a highly reactive nano zero valent irons using starch and mercapto acids as stabilizing agents. Recently, we synthesized a composite of starch stabilized nano zero valent iron (nZVI) with graphene nano particles. The composite (Gn-nZVI) nano particles were characterized for its properties using SEM, FTIR, XRD, BET surface area and zero point charge (pHzpc). The surface area and pHpzc of NZVI-Gn composite was reported as 525 m^2 g^{-1} and 8.5, respectively. It was then tested for hexavalent Cr removal in water. Cr(VI) is a highly toxic ion in industrial wastewaters. Highest Cr(VI) removal was achieved at pH 3 whereas 67.3% was removed within first few minutes, and reached its equilibrium within 20 min. The partitioning of Cr(VI) at equilibrium is perfectly matched with Langmuir isotherm and maximum adsorption capacity of the NZVI-Gn
composite is 143.28 mg g^{-1}.

Atmospheric particulates

and the associated pollutants can eventually deposit on ground surfaces as pollutant build-up and can subsequently be transported to receiving water bodies as pollutant washed-off during rainfall-runoff events. Kandy city is the second largest city in Sri Lanka situated in a valley at high elevation. The pollution of receiving waters has far reaching consequences as Kandy town is well-endowed with water resources including the Mahaweli River. As such degradation of water quality of Mahaweli River can have adverse consequences on its sensitive ecosystem. Additionally, they can have human health consequences as the river water is still been used for potable purposes. Hence, the objectives of the study are to monitor heavy metals and hydrocarbons attached to particulate matter around Kandy.

Table 1. Metal concentrations in selected samples

	Metal concentration, ppb							
Location	**Al**	**Cr**	**Fe**	**Ni**	**Cu**	**Zn**	**Cd**	**Pb**
Fire dept	13210	52	24589	31	100	2514	17	75
Police station	5693	21	11103	14	39	873	6	39
Railway station	4611	33	9382	19	35	461	1	41
IFS	3307	25	36052	13	13	152	1	8

MPhil/M.Sc. Students : Mr. Prasanna Kumarathilaka, Mr. Indika Herath, Ms. Sonia Mayakaduwa, Mr. Yohan Jayawardhana, Mr. haranga Bandara, Ms. Lakshika Weerasundara, Ms. Waruni Geethika Kumari, Mr. Subhashana Wijebahu, Ms. Udari Siriwardhane

Key publications

1) Vithanage M,*Mayakaduwa SS, Herath I, Ok YS, Mohan D (2015). Kinetics, thermodynamics and mechanistic studies of carbofuran removal using biochars from tea waste and rice husks. Chemosphere. DOI: http://dx.doi.org/10.1016/j

2) Vithanage M,* Rajapaksha AU, Bootharaju MS, & Pradeep T (2014). Surface complexation of fluoride at the activated nano-gibbsite water interface. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 462, 124-1301.

3) Rajapaksha AU, Vithanage M,* Ok YS, Oze C (2013). Cr(VI) formation related to Cr(III)-muscovite and birnessite interactions in ultramafic environment. Environmental Science and Technology 47:9722-9729.

From left: Mr. Indika Herath, Ms. Lakshika Weerasundara, Mr. Yohan Jayawardhana, Ms. Sonia Mayakaduwa, Dr. Meththika Vithanage, Mr. Tharanga Bandara and Mr. Prasanna Kumarathilaka

M.A.K. Lakshman Disanayaka

Research Professor
E-mail: makldis@yahoo.com
Tel: +94 081-2232002

Condensed Matter Physics & Solid State Chemistry

Condensed Matter Physics deals with the synthesis and characterization of technologically important novel solid state and quasi-solid state materials. Under the Condensed Matter Physics project of the NIFS, we focus on developing novel materials and devices for energy generation and utilization. Synthesizing novel solid polymer and quasi-solid polymer electrolytes and suitable cathode materials for Mg^{++} ion rechargeable batteries, fabricating and characterizing electrochromic display devices with novel intercalation materials, optimization of the cadmium sulfide layer for efficiency enhancement in thin film p-n junction CdS/CdTe solar cells, fabrication of low cost water filters from electro spun polymer nanofibres for removing bacteria and arsenic from drinking water are some of the sub-projects completed under the Condensed Matter Physics project during 2014-2015.

Rutile (TiO_2) is an important low cost mineral available in Sri Lanka. One of the important research findings from our work is the possibility of using a purified grade of TiO_2 as a multifunctional material. This material can be used as a cathode material for low cost, rechargeable magnesium ion (Mg^{++}) batteries, which has a great potential to replace the expensive lithium ion rechargeable batteries in the future. The possibility to use TiO_2 in Electrochromic Display Devices (ECDs) is another important research finding from our work.

Under our sub-project on electrospun nanofibres, we have used polymer nanofibres prepared by electro spinning successfully to fabricate an antimicrobial water filter. These nanofibres, when functionalized with TiO_2, have the ability to remove Arsenic from contaminated drinking water quite effectively.

The world currently relies heavily on fossil fuels, such as oil (petrol, diesel, kerosene etc), coal and natural gas for its energy needs. Fossil fuels create massive pollution in the many

types of renewable energy resources, such as solar energy and wind energy are more eco-friendly and constantly replenished and will never run out. Sunlight, can be used for generating electricity using solar cells and solar panels.

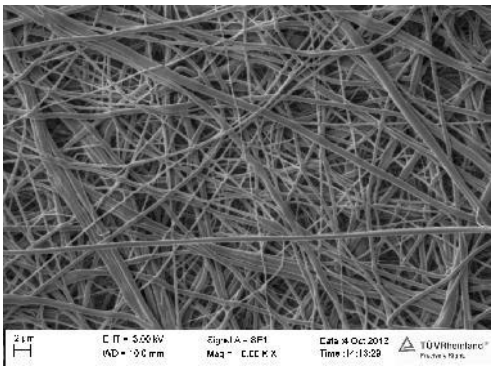


Figure 1: FESEM micrographs of an electrospun Cellulose Acetate polymer nanofibre membrane used to fabricate the antimicrobial water filter

At present, commercial solar panels are made from thin film silicon solar cells which are quite expensive to be used by the consumer. A low cost solar cell technology, currently undergoing extensive research is the dye- sensitized solar cell (DSSC) technology, which was invented by Michael Gratzel and Brian O'Regan in 1991. A typical DSSC consist of a wide band semiconductor such as TiO2, sensitized with a dye, a redox electrolyte and a Pt counter electrode (Figure 2).

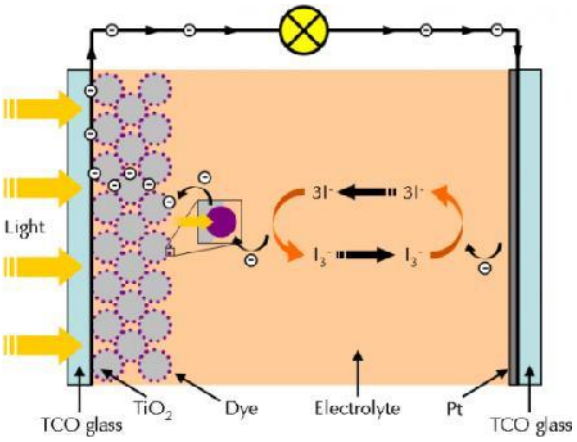


Figure 2: Schematic diagram of a dye sensitized solar cell

Conventionally used solution electrolyte-based dye- sensitized solar cells (DSSCs) can have efficiencies as high as 11 %, or even greater, but they often suffer from potential leakage and problems associated with electrode corrosion

Even though the conversion efficiency of dye-sensitized PV cells is lower than that of some other thin-film solar cells such as silicon solar cells, their price to performance ratio is sufficient to make them an important player in the solar market, particularly in building-integrated photovoltaic (BIPV) applications.
Most of the present research on DSSCs worldwide is focused on enhancing the efficiency by improving spectral absorbance by making structural modifications in the photoanode, replacing the liquid electrolyte with solid state or quasi solid state (gel) electrolytes and improving the electron transport within the photoanode and the electrolyte.

Under the Solid State Chemistry project of the NIFS, during 2013-2015 period we have focused our research efforts on enhancing the efficiency of dye sensitized solar cells by several different approaches. Traditionally, in a typical DSSC with iodide/tri-iodide redox couple, the electrolyte is made with a single cationic iodide salt, such as potassium iodide (KI), or lithium iodide (LiI) or tetrapropylammonium iodide (Pr_4NI). One of the important research findings in this context from our recent work at NIFS is the enhanced efficiency when the electrolyte contains a mixture of two iodide salts, one with a small size cation such as KI and other with a bulky cation, such as Pr_4NI. This **"***mixed cation effect***"** has been observed in DSSCs with different binary iodide salt mixtures and it is well established now (Figure 3).

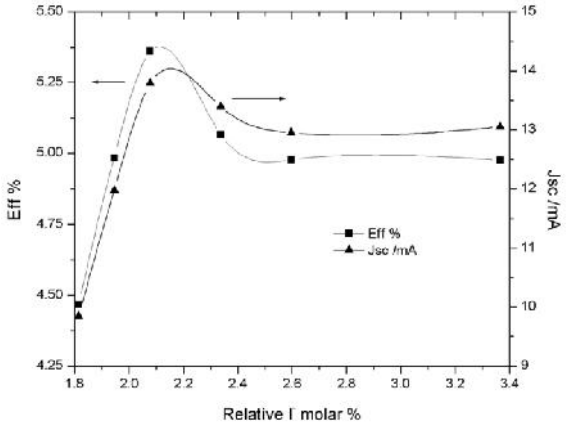


Figure 3. Variation of efficiency and current desnity with iodide ion molar ratio in the DSSC with PAN:EC:PC:KI+Pr_4NI, I_2 gel polymer electrolyte.

In one of our projects, we have been successful in designing fabricating an innovative type of three layer composite photoanode structure consisting of an electrospun TiO_2 nanofibre layer sandwiched between two TiO_2 nanoparticle layers. This three layer TiO_2 NP/NF/NP composite photoanode has been used successfully to enhance the efficiency of DSSCs by improved light harvesting. The increase in light harvesting is believed to be due to scattering of light within the composite photoanode structure (Figure 4). The combined use of the TiO_2 three layer composite photoanode and the mixed cation iodide salt containing electrolyte has increased the solar cell efficiency from 5.38% to8.80% and represents an impressive overall efficiency enhancement by 64% compared to a corresponding DSSC made with TiO_2 nanoparticle (NP) photoanode and electrolyte with the single iodide salt Pr_4NI. A paper has been submitted for publication in an indexed journal.

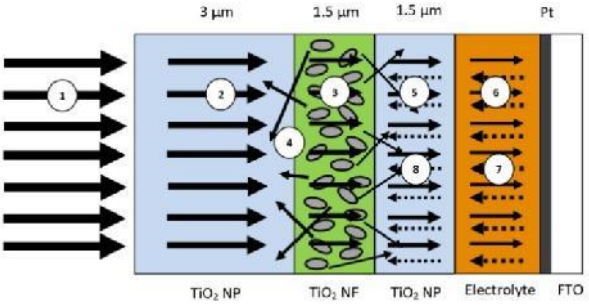


Figure 4. Schematic diagram of the TiO_2 NP/NF/NP three layer photonode showing the enhanced light harvesiting by multiple scatting effect.

M.Phil. Students: C.A. Thotawatthage, J.M.K.W. Kumari, A.M.J.S. Weerasinghe
M.Sc. Students: A.A. Hasitha Jayanthirathne, D. Alakakoon

ey publications:

1) Dissanayake, MAKL, Thotawatthage CA, Senadeera, GKR, TMWJ Bandara, Jayasundera WJMJSR, MellanderB.- E . (2012). Efficiency enhancement by mixed cation effect in dye-sensitized solar cells with PAN based gel polymer electrolyte. J Photochemistry & Photobiology: A Chemistry, 246, 29–35.

2) Dissanayake, MAKL, Divarathnea, HKDWMNR, Thotawatthage CA, Dissanayake, CB, Senadeera, GKR, Bandara, BMR. (2014). Dye-sensitized solar cells based on electro spun polyacrylonitrile (PAN) nanofibre membrane gel electrolyte. (2014) 76–81.

3) Dissanayake, MAKL, J. M. K. W. Kumari, G. K. R. Senadeera, C. A. Thotawatthage (2015). Efficiency enhancement in plasmonic dye-sensitized solar cells with TiO_2 photoanodes incorporating gold and silver nanoparticles. Journal of Applied Electrochemistry, 1-12, (DOI10.1007/s10800-015-0886-03)

From Left: Ms. N. Sanjeewdharshani, Ms. Kalpani Kumari, Prof. Lakshman Dissanayake, Dr. Rohan Senadeera, Mr. Chathuranga Thotawattage, Mr.Janith Weerasinghe

Athula Wijayasinghe

Research Fellow athula@ifs.ac.lk
+94-812232002
http://www.ifs.ac.lk/research_units/Nanotechnology_Physics_of_Materials.php

Nanotechnology/Physics of Materials

The emerging fields of Nanotechnology and Physics of Materials are mainly responsible for most of the present technological advances in Advanced Materials. Already nanotechnology has created many new materials/devices for a vast range of applications. However, being in a developing country but rich with minerals resources, which can play a major role in advanced/nano-materials based industry, we seriously mind these factors inherent to our country when adapting or contributing to those scientific/technological advances.

Sri Lanka is well known for possessing a variety of economically useful minerals and related materials. However, higher value addition to these important natural resources has almost been lacking, due to dearth of advanced scientific research conducting in the country along this line. In the light of this, our project emphasizes on performing target oriented fundamental and advanced scientific investigations leading to develop Sri Lankan minerals and related materials for nano-technological and advanced industrial applications. Apart from that, we also involved with the exploration of low-cost but performance enhance novel advance semiconducting materials with special attention on energy conversion and storage applications. Going alone this line, within these first three years, we initiated and conducted target oriented fundamental and advanced research on three different are as:

Natural vein graphite; for the direct use in Li-ion rechargeable batteries, synthesis of graphite based nano-materials, structural modification to enhance ion intercalation for upcoming Na-ion, Mg-ion and their hybrid rechargeable batteries.

Advanced transition metal oxide semiconducting materials; synthesized by developing novel low-cost nano- technological methods and doping with cheaper additives, for electrode applications in fuel cells and rechargeable batteries.

Minerals and related materials for efficient water purification; by identifying novel candidate materials and developing the identified materials into more effective structures through structural modification, surface area enhancement, compositing, nano-particle formation etc

Nanotechnology/Physics of Materials Project of NIFS commenced its work in January 2013. At present, the following three sub-projects, which emphasize on the basic and fundamental scientific aspects on advanced synthetic materials and advanced materials derived from Sri Lankan minerals are carried out under this project.

Investigation of ion intercalation in advanced materials derived from Sri Lankan graphite *(aiming for energy storage/nano-material applications)*

Primarily, investigations on deriving advanced materials out of Sri Lankan natural graphite are carried out under this sub project. Many specialized markets such as rechargeable batteries and nano-materials command premium prices for natural graphite.

Sri Lanka is the only commercial producer of vein graphite, which is the rarest and most valuable form of graphite. But it requires thorough upgrading of our graphite, carried out through comprehensive purification control the size of the and modifications.

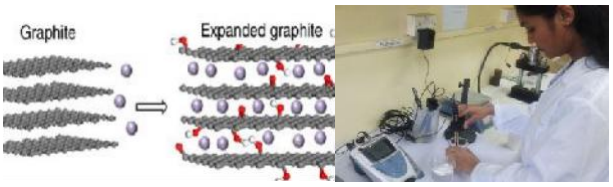
Collection of vein graphite from underground mines

Our project has so far invented several different purification methods resulting over 99.9% purity on all four different structural varieties of Sri Lankan natural vein graphite. These ultra-pure graphite varieties are further modified aiming to different advanced technological applications.

Under that, investigations are carried out on modification of graphite surface to be more electrochemically active, for the use in rechargeable Li-ion battery (LIB) electrodes. Accordingly, our recently developed needle platy vein graphite anode shows a reversible capacity of 378 mAhg-1, which is even higher than the theoretically expected capacity of 372 mAhg-1.

Raw graphite, Graphite electrode, LIB with our electrodes

Under a more advanced fundamental investigation, our ultra-purified graphite varieties are subjected to structural modification through expanding the lattice inter-planer space. Here, it is mainly concerned with the enhancement of ion intercalation/de-intercalation mechanisms of the expanded graphite. The preliminary aim of this work is to structurally modify our graphite suitable for upcoming Na-ion and Mg-ion batteries.



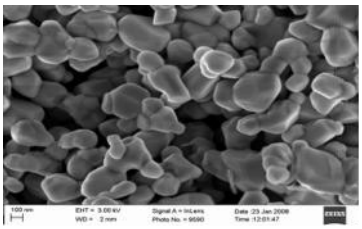
Inter planer expansion of vein graphite

Our recent investigations revealed a strong dependence of the degree of expansion on vein graphite variety and the oxidant used.

Study of mechanism and effect of dopants in advanced transition metal semiconductors *(aiming for energy storage/ conversion applications)*

This sub-project mainly emphasizes on developing advanced semiconducting materials through novel nano- material synthesis methods. For that, we have developed the low-cost wet chemical Glycine Nitrate Combustion (GNC) method to precisely control the size of the resulting powder particles into nano-scale. This finding is based on an investigation conducted to understand the effect of the composition of precursor on crystal growth.

G:N Ratio	0.2	0.4	0.6	0.8	1.0
Particle Size (nm)	78	68	64	62	58



Synthesis of nano particles by controlling Glycine:Nitrate (G:N) ratio in GNC process

Furthermore, fundamental and advanced scientific investigations are carried out to study the of effect dopents on enhancing electrical and electrochemical property in some important advanced semiconducting transition metal oxide systems.

The developed materials, which show promising characteristics are subjected to electrochemical studies through electrode fabrication and assembling into standard rechargeable cells.

Transition metal oxide systems d eveloped with additives for the electrode application in novel rechargeable batteries

$Li(Ni_{1/3}Mn_{1/3}Co_{(1/3-x)}M_x)O_2$, [M = Al, Fe, Mg, Ba, Na, Cu, Zn] for Li-ion battery cathodes

$NaNi_{0.4}Mn_{0.4}Co_{0.2}M_xO_6$ [M = Li, Mg, Ba, Ag, Al, Cu, Fe, Ti ..] for Na-ion battery cathodes

$Mg_{1-x}M_xO_2$ [M = Mn, Co ..] for Mg Mg ion battery anodes

MTiO [M = Mg, Na ..] for Na and-ion battery cathodes

$Li(Ni_{1/3}Mn_{1/3}Co_{1/3})O_2$ cathode material shows a reversible capacity of 188 $mAhg^{-1}$, which is much higher compared to 127-1 mAhg of the expensive LiCoO2 used in commercial Li-ion rechargeable batteries. Further investigations are carried out with the other developed

material systems intending for the novel Na-ion and Mg- ion rechargeable batteries

Assembling and testing of batteries with our developed materials

Structural development of minerals and related materials *(aiming for efficient water purification)*

Though variety of potential local minerals have already being identified research findngs to practical use of efficient water purification is lacking in our country. A main reason behind this is the unsuitability to use our minerals directly as of the raw form in water filters

In addressing this, we recently imitiated a fundamental materials scientific but targeted research project on developing these alredy identified potential materials into more effective structures for water purification, through structural modification, through structural modification, surface area enhancement, compositing, nano-particle formation etc.

Testing of our developed materials for water purification

M.Sc./M.Phil Students **:** S. Hewathilake, N. Karunarathna, N. Rathnayake, K. Heshan, T. Senevirathna, T. Pathirana, N. Rupasena

Key publications **: 1)** Samarasingha P, Wijayasinghe A, Behm Dissanayake X L, Lindbergh G M, (2014). Development of cathode materials for lithium ion rechargeable batteries based on the system $Li(Ni_{1/3}Mn_{1/3}Co_{(1/3-x)}M_x)O_2$, (M = Mg,Fe, Al and x = .00 to 0.33), Solid State Ionics, 268; 226-330.

: 2) Rathnayake N, Hewathilake S, Wijayasinghe A, Pitawala A, Balasooriya N,(2015). Development Of enhancement, compositing, nano-particle formation etc. expanded graphite from Sri Lankan natural vein graphite by chemical oxidation, Proceedings, 2nd International into more effective structures for conference on Nanoscience and Nanotechnology. 42.

From Left: Mr. WG Jayasekara, Mr. RICN Karunarathne, Dr. HWMAC Wijayasinghe, Mr. HPTS Hewathilake, Mr. GDK Heshan, Ms. RMNM Rathnayake, Ms. TC Senavirathna

Jayasundera Bandara

esearch Professor
andaraj@ifs.ac.lk
94-812232002
ttp://www.ifs.ac.lk/research_units/photochemestry.php

Photochemistry

Photochemistry project involves mainly in the field of renewable energy research and the project focused its research on development of new materials for photoconversion of solar energy into chemical and electrical energies. The Photochemistry project also involves investigation of low cost water and air purification methods for the abatement of industrial pollutants by using sunlight.

Efficient water splitting with solar light is one of the most promising technologies for solar hydrogen p roduction. However, this is one of the problems considered as unresolved problems in Physical Chemistry field. There are three fundamental requirements for efficient water splitting; (a) sunlight must absorbed efficiently by light harvesting materials, (b) photoexcited electron and holes must be separated in space to prevent recombination, (c) photoexcited charge must be energetically and kinetically able to perform a chemical transformation. In Photochemistry Group at NIFS, we investigate fundamentals of all three aspects.

Conversion of solar energy into electrical energy: (solar cells) The fundamental requirements (a), (b), (c) mentioned above apply for solar cell field and hence we investigate all these factors in our research.

Remediation of contaminated water and air: Pollution of water and air by waste chemicals is a major concern and photochemistry group carries out advanced oxidation technologies for the remediation of these pollutants.

Sonolyis of water: The accepted mechanism of sonolyis of water is questionable and we do experiments to understand and clarify the mechanism.

Water quality and the prevalence in CKDu in Rajarate area: In this project, the quality of drinking water to the prevalence of CKDu in the region was investigated.

The solar cells currently available in the market based on silicon material are very expensive. As an alternative to Si solar cell, dye sensitized solar cells (DSSC) has been introduced and the key material of DSSC is the large band gap oxide semiconductor such as TiO_2, ZnO, and SnO_2 decorated with light absorber dye molecules. In typical conventional DSSCs, randomly oriented TiO_2 nanoparticles were utilized as the oxide semiconductor material for dye adsorption and as an electron transport medium. Due to random orientation of nanoparticles, the electrons which are injected from the exited state of the dye molecules (HOMO) to the conduction band of the TiO_2 are moving in a random pathway which may result in higher charge carrier recombination reducing performance of the solar cell. In order to facilitate direct electron transport within the electron conducting material, 1-D nanomaterials such as arrays of nanotubes and nanorods etc. can be used as they provide short direct pathways. In Photochemistry group of NIFS synthesis different 1-D nanostructures such as 1-D- TiO_2, SnO_2, ZnO as shown in Figure 1.

Figure 1. SEM images of 1-D TiO_2, SnO_2 and ZnO

These 1-D structures exhibit superior solar cell performance and the table 1 shows the present solar cell efficiencies an future targets.

Table 1. Solar cell performance

electrode	efficiency	target
$TiCl_4$-treated TiO_2 NT	7.6% (L/E) 5.5% (S/E)	10%
TiO_2 NT/NP	8.0%	<10%
ZnO NR	3.9%	10%

In a similar direction, conversion of solar energy into chemical fuels such as hydrogen is highly encouraged and it is an important area of research. TiO2 is the most widely used photocatalytic material. Though TiO2 is a highly stable photocatalyst with appropriate energy positions for water splitting reaction, practical use of TiO2 is limited as it absorbs mainly high energy photons in the UV region of thesolar spectrum.

However, successful methods have not been reported to use the IR region of the solar spectrum for photolysis of water. Advantage of such a system is that IR waves are available from the sunset to sunrise and the solar spectrum consists of 47% IR radiation. We have recently developed Ag2O/TiO2 photocatalyst that utilizes IR region and produce hydrogen from water and water/methanol mixture. This is the first report on purely IR based

photocatalyst and a possible photocatalytic mechanism is proposed as shown in Figure 2.

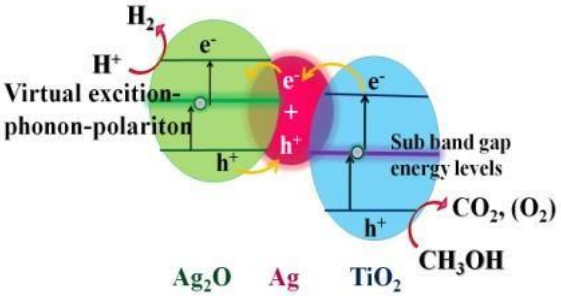


Figure 2. Schematic proposed photocatalytic process of $Ag_2O/Ag/TiO_2$ photocatalyst.

For the observed infrared photocatalytic activity of Ag_2O/TiO_2 photocatalyst, a Plasmon assisted photocatalytic activity and/or a sub-band gap phonon- assisted multi-photon excitation mechanism are proposed. In the proposed ONF-phonon assisted process, the ONF generated at the nanostructures could excite the coherent phonons in the nanostructures forming virtual excition-phonon-polariton as shown in Fig. 2. These quasi particles can excite the electrons to the phonon level and successively to the CB. This type of multi-step excitation process is possible even the incident photon energy is lower than the band gap energy. Hence, the IR initiated catalytic activity of Ag_2O/TiO_2 photocatalyst could be mainly assigned to sub- band gap filling as it involves a multi-photon process as well as trapping and de-trapping of electrons and holes created by IR photon excitation.. However, we cannot totally exclude the surface Plasmon initiated reaction mechanism and hence further experiments are needed to distinguish the proposed reaction mechanisms.

Development of effective and inexpensive oil-water separation techniques for the cleaning of the oil polluted water is of highly demanding task as industrial oily wastewater is a worldwide problem. For the purpose of effective oil/water separation, a novel kind of superhydrophilic (underwater superoleophobic) filter is fabricated with naturally and hydrothermally treated mica particles. The double layered membrane filter consists of a stainless steel mesh on which a layer of hydrothermally treated mica particles are electrodeposited and the second layer of natural mica layer is sprayed on the first hydrothermally deposited mica layer.

The mica coated membrane shows superamphiphilic and superhydrophilic/ superoleophobic (contact angle>159°) characteristic in air and underwater respectively. The membrane can separate range of oil-water mixtures with
oil/water separation efficiency of ~98-99%. Surface adhesion properties of mica is enhanced by the hydrothermal treatment of mica and the higher roughness of the mica layer is maintained by the natural mica.

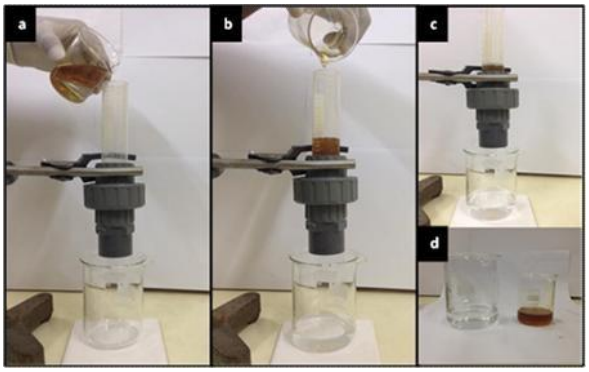


Figure 3. water/oil seperation process (a) complete setup for the separation (mesh fixed inside the union) (b,c) oil/water separation process (d) separated oil and water (right side - oil, left side - water).

A research project on chronic kidney disease of unknown etiology (CKDu) was commenced recently. The histopathological results clearly demonstrated that the mice fed with drinking water containing WHO recommended levels of Cd, F along with hardness, leading to early lesions similar to those of CKDu. The toxicity effect of Cd-F, Cd-hardness, F-hardness or Cd alone on kidney is less pronounced than that of Cd,-F,- hardness combination suggesting a synergic effect among Cd,-F-hardness. Our investigation suggests existing of a synergic effect especially among Cd, F and hardness of water which could lead to kidney damage.

Ph.D. Students: A. Manjceevan, A. Anapayan, H.M.S. Wasana
M.Sc./M.Phil Students: K.M.S.D.B. Kulatunge, K.U.B. Gunatilka, K.C.I. Buddika, D.S. Dharmagunawardena, K.N.L..D. Silva, R.M.P. Wanigasekara, K.G.S.P.B. Samarakoon, A.M.B. Kulathunge, R.D. Senevirathne

Key publications

1) Wasana HMS, Aluthpatabendi D, Kularatne WMTD, Wijekoon P, Weerasooriya R, Bandara J, (2016). Drinking water quality and chronic kidney disease of unknown etiology (CKDu): synergic effects of fluoride, cadmium and hardness of water, *Environmental Geochemistry and Health*, 38, 157-168

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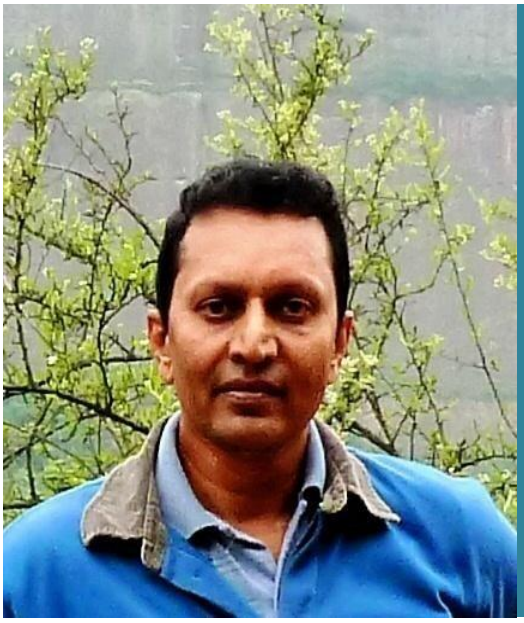
From Left: Ms. DS Dharmagunawardane, Mr. KCI Buddika, Mr. A Manjceewan, Mr. KMSB Kulathunge, Mr. KUB Gunathilake, Mr, A Anapayan, Mr. KNLD Silva



Deepal Subasinghe

AssociateResearch Professor
deepal@ifs.ac.lk
+94-812232002 p://www.ifs.ac.lk

Renewable Energy, Natural Resources & Cleaner nvironment

Sri Lanka, as a developing country, faces many challenges on its way to the future. Discovering, evaluating and development of the natural resources including renewable energy sources, efficient use of existing sources as well as maintaining of cleaner environment are some of the foremost challenges Sri Lanka faces. Our research projects are aiming to find ingenious solutions to some of those issues through basic and advanced research.

A project on geothermal resources of Sri Lanka aims to evaluate the geothermal resources with a view to utilise them for national development. As the first phase of the project, a comprehensive geophysical survey was conducted in the areas of known geothermal resources.

Geophysics can also be used in finding and evaluating of mineral resources. Although the general techniques are known, it is essential to develop a methodology to suit the specific conditions in each situation. A project to estimate the subsurface contents and exact boundaries of an economic mineral deposit was completed successfully with the financial support of the NSF. Geochemical and geological information can also be used in this context.

Thermoelectricity project was initiated with the objective to introduce this new area of research to Sri Lanka. Thermoelectric generators use “Seebeck Effect” to convert heat energy directly into electrical energy. One of the greatest and unique advantages of thermoelectricity is the ability to increase the overall efficiency of an existing system by ‘scavenging’ waste heat. Other advantages include the ability to operate with any source of heat and at any temperature range.

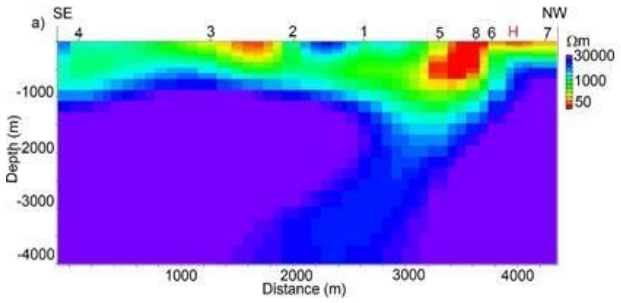
Electrochemical water purification is useful in cleaning the industrial effluents, especially organic contaminants. Development and optimisation of suitable anodes play a major role in this research. Anode stability, electrical consumption and efficiency are important factors to be con sidered.

Geothermal Resource Mapping: World energy experts have long realized the importance of finding alternative and renewable energy sources to replace the non- renewable energy, especially fossil fuel. Dependence on fossil fuel for energy requirements makes us vulnerable to external pressures and we spend a huge amount of foreign exchange. Therefore, it is important to develop our own energy sources and reduce our dependence on imported fossil fuel.

As a pioneering project, the National Institute of Fundamental Studies (NIFS) initiated a project on mapping geothermal resources in Sri Lanka, in 2009. Sri Lanka, although not located on a highly active geothermal region, still has geothermal resources which may have a potential of generating electricity and contributing to the energy needs of the country.

As the first phase of the project, NIFS, in collaboration with few other institutes, conducted the first ever comprehensive geophysical survey. In this survey, passive and active geophysical techniques were employed to investigate the near-surface as well as deep structures of the earth. 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, above two techniques can provide information on geological structures, heat sources and water resources hidden under several meters to several hundred kilometers of the earth, if necessary. Since the MT equipments are very expensive, we requested the support of British group that brought the equipments on loan with experts on geophysics. The British experts offered their time, equipment and expertise free of charge, as a goodwill gesture.

We processed the data to produce resistivity profiles that represent the sub-surface structures as shown here.

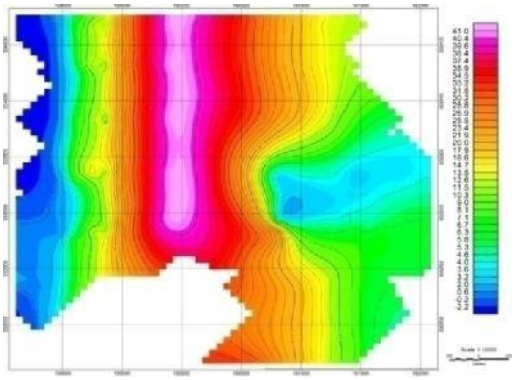


Resistivity profile across Kapurella thermal spring area. Further investigations on geothermal resources of Sri Lanka are continued with geological, geophysical and geochemical tools available.

Estimating the extent of Eppawala Phosphate deposit:

One of the major mineral resources in Sri Lanka is the phosphate ore at Eppawala. Although the mining and exploitation are done, no attempt has been made to estimate the extent of the deposit or determine the boundaries since the initial estimates made using bore holes, several decades ago.

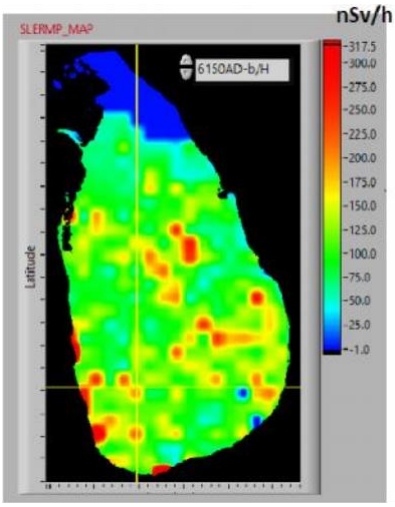
In this project, modern geophysical techniques are employed to demarcate the phosphate body from the surrounding country rocks. Differences in magnetic signatures of the phosphate ore and the surrounding country rocks are the key to differentiate the two. Systematic mapping of the magnetic anormalies helped us to identify the boundaries of the phosphate ore. Our work also revealed that the phosphate deposit extends to areas much further than the areas known before. This project is funded by the National Science Foundation.



Magnetic anomaly map showing the boundaries of phosphate deposit at Eppawala.

Radon Mapping Project:

Radon is the single-most contributor to the natural radiation we are exposed to on earth. Level of radon changes due to many factors. For the first time in Sri Lanka radon monitoring programme was initiated in collaboration with the Atomic Energy Authority of Sri Lanka. With passive and active methods, natural radiation levels of are monitored and mapped around the country.

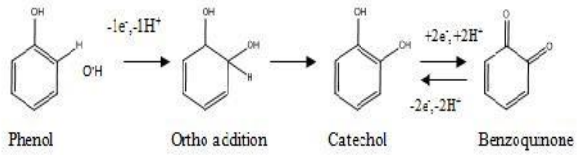


Natural background radiation levels in Sri Lanka

Electrochemical purification of waste water:

This project which has now been successfully completed, which was focussed on developing suitable anode material to use in electrochemical purification of water. Phenol was selected as the model organic pollutant to be tested. Several combinations of potential electrode material were tested and optimised. Electrodes made with $Ti/IrO_2–Sb_2O_3$ found to be the best in

overall efficiency, cost, durability and stability. Reaction mechanisms were studied and the following mechanism is proposed for phenol oxidation.

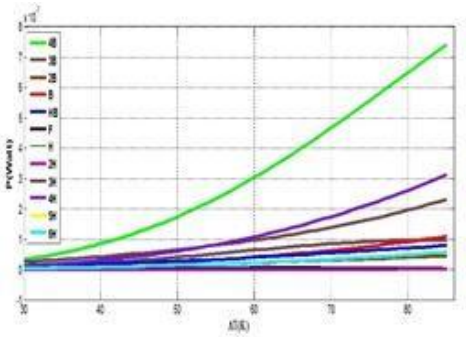


Thermoelectricity Research:

Although new to Sri Lanka, research on thermoelectricity is a fast growing area globally, mainly due to its ability to increase the energy efficiency of existing systems and to generate electricity from any source of heat, regardless of the temperature range. Some other advantages of thermoelectric generators (TEGs) are the scalability (from a large plant to nano-scale module), reliability and durability due to no moving parts. TEGs can scavenge heat energy and convert it to useful electric energy using thermoelectric effect, known as the *Seebeck* effect.

At NIFS, some low-cost TEGs are designed and tested using industrial grade components while new material are developed to increase the "figure of merit", which has direct connection to the overall output.

TEGs made using commercially available materials



Power output of different material compositions

M.Sc./M.Phil Students **:** D.R. Charles, K.V.P.B. Kobbekaduwa, P.B. Jayathilake (completed MPhil In 2015), S.A. Samaranayake

Ph.D. Students **:** T.B. Nimalsiri (completed MPhil in 2015)

Key publications

1) Nimalsiri TB, Suriyaarachchi NB, Hobbs B, Fonseka M.,Manzella A, Dharmagunawardena HA, Subasinghe ND (2015). Structure of a low-enthalpy geothermal system inferred from magnetotellurics — A case study from Sri Lanka. *Journal of Applied Geophysics*, 117, 104–110.

2) Jayathilaka PB, Pathiraja GC, Bandara A, Subasinghe ND, Nanayakkara N (2015). Electrochemical oxidation of phenol on Steel/IrO_2-Sb_2O_3 electrodes: a mechanisms study, *Canadian Journal of chemistry.* 93, 536-541.

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From left: S. Opatha, DR Charles, TB Nimalsiri, KVPB Kobbekaduwa, Prof. ND Subasinghe, PB Jayathilake, SA Samaranayake

Asiri Nanayakkara

Senior Research Professor
asiri@ifs.ac.lk

Single Bubble Sonoluminescence

Single-Bubble Sonoluminescence (SBSL) is observed when a single gas bubble, which is acoustically levitated in a liquid, undergoes nonlinear oscillations in synchrony with the applied sound field and emits sub-nanosecond flashes of light at the point of maximum implosion. As the bubble collapses, vibrational energy gets concentrated by at least a factor of 4x1011 to produce flashes of light in the UV range. These flashes of ultraviolet light have durations much shorter than a nanosecond. At the latter stages of the collapse, both the temperature and the pressure inside the bubble reach extreme values such as 20,000K and 3,500 atm respectively. Also the bubble wall reaches acceleration over 1011 g near the maximum implosion. SBSL is observed by only with the bubbles having ambient radii between 1 µm to 10 µm and during the collapse radii of these bubbles come down to 0.1 µm to 1µm.

The details of physical conditions and chemical processes in the bubble at the last stage of the bubble collapse have not been understood completely. The mechanism of the phenomenon of sonoluminescence is still unknown.

We investigate the physical conditions at the last stage of the bubble collapse in SBSL as well as the mechanism of light emission using theoretical and computational techniques as well as experimental methods.

We experimentally investigated the temperature dependence of intensity of single-bubble sonoluminescence (SBSL) in 85 wt %. sulfuric acid. It was found that the intensity increases as temperature increases from 15 °C and 25 °C, confirming what has been predicted by A. Moshaii et al. theoretically. This behavior, however, is completely opposite to what has been observed for water. Above 25 °C, the behavior of intensity of SBSL in sulfuric acid is found to be independent of the liquid temperature.

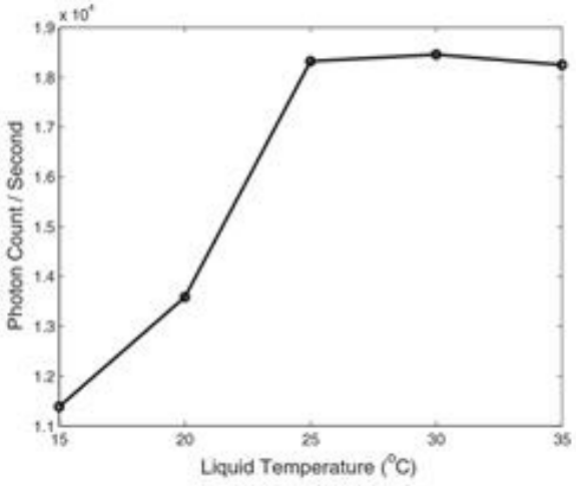


Figure 1. Number of photons detected per second by the PMT for five different temperatures.

Moreover, it was observed that as the temperature increases, contribution to total intensity from the UV portion of the spectrum increases while contribution from the visible portion decreases, indicating higher bubble temperatures at higher liquid temperatures.

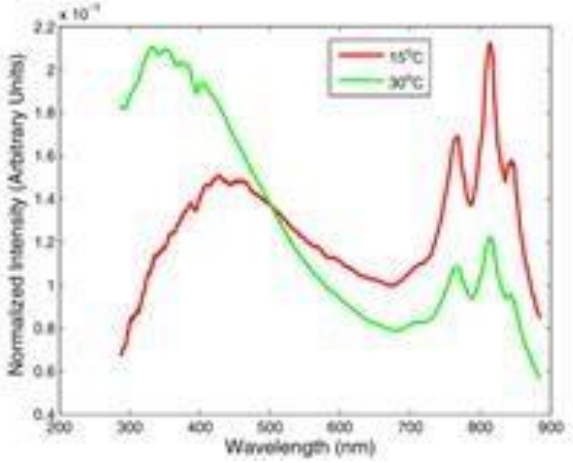


Figure 2. SBSL spectra of 85 wt % sulfuric for 15 °C and 30

°C. Ar emission lines are most prominent in 15 °C. Nevertheless, Ar emission lines are observed at all five temperatures: 15, 20, 25, 30, and 35 °C.

Results of this experiment further indicate that the intensity threshold at each temperature is not determined by the shape or the positional stability conditions as expected, but by the driving pressure at which the transition from SBSL to multibubble sonoluminescence (MBSL) takes place.

Reaction paths and barrier heights are useful in determining what reactions and reaction paths are favorable during the bubble collapse. This information will be valuable in determining chemical processes which are taking place inside the bubble at the collapse. In this project we use accurate electronic structure methods to construct potential energy surfaces and to calculate reaction paths and barrier heights of radical reaction which are relevant to SBSL. Reaction rates and mechanisms involving SO and NO radicals are studied using ab initio electronic structure methods (using GAUSSIAN 09) and transition-state theory calculations (using POLYRATE 2010) for the temperature range 200 K-2000 K.

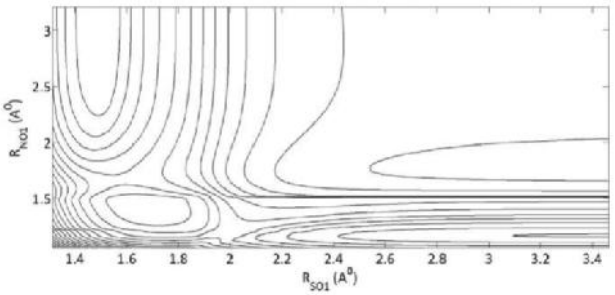


Figure 3. A potential energy contour plot for SO+NO-> S + NO_2 reaction. R_{NO1} and R_{SO1} are bond lengths of NO and SO respectively.

The rates calculated with variational transition state theory show that for the temperature range 200K – 2000 K, three parameter Arrhenius equation produces the most accurate reaction rates.

M.Phil. students : Mr. Prabhath Herath, Mr. Manoj Wijesingha, Ms. Vibodha Bandara

Key publications

1) Bandara V, Herath P, Nanayakkara A (2015). *"Temperature dependence of single-bubble sonoluminescence threshold in sulfuric acid: An experimental study"* Physical Review E 91, 063015

2) Wijesingha M, Nanayakkara A (2015). *"Determination of reaction mechanisms and rates involving SO and NO radicals"* Journal of Molecular Structure 1102: 275

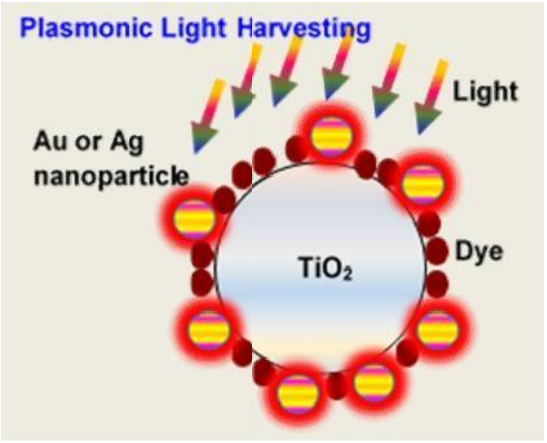
G.K. Rohan Senadeera

Visiting Associate Research Professor
+94-812200

Condensed Matter Physics & Solid State Chemistry

Dr.Rohan Senadeera is a co- investigator of Condensed Matter Physics and Solid State Chemistry group of the NIFS in which, focuses its research activities on developing novel materials and devices for energy generation and utilization.

In one of the NIFS sub-projects carried out by the group, the use of gold (Au) and silver (Ag) nanoparticles (NP) incorporated into the TiO_2 photoanode has hown enhancement of the photocurrent of the DSSC by the surface plasmon resonance effect. The best conversion efficiency of the reference DSSC without Au and Ag NPs in TiO_2 was 5.12 % under the illumination of 100 mW cm^{-2} (AM 1.5). The efficiencies of plasmonic DSSCs after incorporating Au NPs and Ag NPs into TiO_2 were 6.23 % and 6.51% respectively. This represents an efficiency enhancement by about 21.6 % with Au NPs and 27 % with Ag NPs compared to the reference DSSC with pristine TiO_2 photoanode. The observed efficiency enhancement has been attributed to increased short circuit current density by enhanced light harvesting by the photoanode aused by the localized surface Plasmon resonance effect of the metal nanoparticles and faster electron transport within the TiO_2 photoanode as evidenced bythe reduced electron life times which improves the electron collection efficiency.



In another sub-project, dye sensitized solar cells fabricated with nitrogen doped (N-doped) TiO_2 electrodes have been studied. A high conversion efficiency of 8.00% was achieved by the dye sensitized solar cells based on the N-doped TiO_2 electrodes while DSSCs with the undopedTiO_2 electrode had an efficiency of 4.22%. The enhancement in the photocurrent density of the N-doped DSSCs was 49% compared with undoped DSSCs. The significant enhanced efficiency of the devices was found to be related to the dye uptakes in N-doped TiO_2 electrodes and the efficientelectron transport due to reduced charge transfer resistance.

Academic Activities

Publications in Journals Book chapters
Intellectual Properties
Publications in Conference Proceedings
Other Publications
Awards and Recognitions
Grants Received
Degrees completed in 2015
Equipment Development

Publications in Journals

Biological Sciences

Alakolanga AGAW, **Kumar NS, Jayasinghe L***, Fujimoto, Y. (2015). Antioxidant property and α-glucosidase, α-amylase and lipase inhibiting activities of *Flacourtia inermis* fruits: Characterization of malic acid as an inhibitor of the enzymes, Journal of Food Science and Technology,52, 8383-8388.

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Intellectual properties

Title: Detection of *rpo*B, *inh*A and *kat*G sequences of *Mycobacterium tuberculosis* complex

PI: Dr. Dhammika Magana-Arachchi

Country: Sri Lanka

Patent Number: 17423

This invention relates to in vitro diagnostic detection of pathogenic bacteria, and specifically relates to an multiplex assay and diagnostic kits comprising oligonucleotides to detect nucleic acid sequences associated with either wild type, multidrug and mono drug resistance (resistance to either rifampin or to isoniazid or both) of *Mycobacterium tuberculosis* complex isolates by using in vitro nucleic acid amplification of the rpoB, inhA and katG gene and detection of amplified products.

Title: Method for removal of antibiotics in water using steam activated biochar derived from burcucumber (*Sicyos angulatus* L.)

PI: Prof. Yong Sik Ok

Team: Dr. Meththika Vithanage, Dr. A. Rajapaksha, Mr. JE Lim

Country: Korea

Patent Number: 10-1536937

This invention relates to developing biochar from invasive plant species present in Korea to remediate antibiotics contaminated water. Different biochars produced at different temperatures by the burcucumber plant were successful in remediating sulfonamides from water

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Bandara T, Vithanage M. *Saagara sampath wanasana sthaai kaabanika sanyoga* (Ocean resource depletion agent - Stable organic compound) 11thFebruary 2015. **Vidusara**.

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Jayawardhana Y, Vithanage M. *Parisarayatath janajeewithayatath haniyaknowana lesa kasla bahara karanna GIS thaakshanaya* (GIS technology for sustainable practices of waste landfill selection) 13th March 2015. **Dawasa**.

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Weerasundara L, Vithanage M. *Mahanuwara vaahana thadabadayata visandumak nathda?* (IS there any solution for Kandy traffic jam? 3rd May 2015. **Lankadeepa**.

Wickramasignhe S, Vithanage M. *Nano thakshanaye thawathpathikadak* (Another aspect of nano technology) 30th September 2015. **Vidusara**.

Wickramasignhe S, Vithanage M. *Nodanuwathwama apawanadsana electronika apadhrawaya* (Electronic waste – as unaware hazardous compound) 15th November 2015. **Lankadeepa**.

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Wijayasinhghe A, Piyathilaka P, *Sri Lankawa thula karyakshama saha mila adu Lithium Ion Battery nipadawime subawaadi balaporoththu* (New hope for Sri Lanka to manufacture efficient and low-cost local Li-Ion batteries). 30th December 2015. **Vidusara**

Awards & Recognitions

Dr. DN Magana-Arachchi delivered an invited speech at the MMDR-5 5th International Symposium-cum- Training Course on Molecular Medicine and Drug Research, International Centre for Chemical and Biological Sciences, University of Karachi, Pakistan, 11-16, January, 2015.

Dr. GKR Senadeera received a position to serve as a member of the Editorial Board of the Journal of Solar Energy Research Updates, Awanti Publishers (2015)

Dr. GKR Senadeera received Presidential Award for his scientific publications in the year 2013, on 18th November 2015.

Dr. GKR Senadeera received University Research Award for 2014, The Open University of Sri Lanka on 19thNovember, 2015.

Dr. Meththika Vithanage received a position to serve as a member of the Editorial Board of the Elsevier Journal of Groundwater for Sustainable Development (2015)

Dr. Meththika Vithanage received Presidential Award for his scientific publications in the year 2013, on 18th November 2015.

Dr. Meththika Vithanage served as a Member of the Board of Governors, Atomic Energy Authority (2015)

Dr. Meththika Vithanage was elected as a Steering committee member – Young Scientists Forum, National Science and Technology Commission, Sri Lanka (2015)

Dr. Viduranga Waisundara received an award for the outstanding contribution in reviewing by the Life Sciences journal, Elsevier B.V., Amsterdam, Netherlands

Dr. Viduranga Waisundara was invited as the quiz master of the Food Quiz Bowl Competition of the 14th ASEAN Food Conference from 24 – 26 June 2015 in Pasay City, Philippines

Dr. W Dittus delivered an invited speech on Lessons from Monkey behavior at Sri Lankan Veterinary Association, University of Peradeniya, 28th October, 2015.

Dr. W Dittus delivered an invited speech on Lessons in accounting and life from Monkeys at Sri Lanka Association for Charted Accountants, April, 2015.

Dr. W Dittus delivered was an invited speaker on critical habitats for the conservation of evolutionary significant units of biodiversity among Sri Lankan primates and other mammals at the National Symposium on Biogeography and Biodiversity Conservation in Sri Lanka in a Changing Climate, 12-13 November, 2015.

Dr. W Dittus received Presidential Award for his scientific publications in the year 2013, on 18th November 2015.

Dr. W Dittus was an invited speaker on History of Sri Lanka at Smithsonian Journeys, June, 2015.

Mr. Prasanna Kumarathilaka delivered an invited talk on E-Waste Management, TALENT soft 2015 program, Advance Technological Institute, Kandy, 04th October, 2015.

Ms. DK Weerasekera – Research Assistant attached to the NIFS Cell biology Project won the Best Poster Award at the 2nd International Conference on Advances in Medical Sciences; 14th-16th April 2015, Malaysia

Ms. Kalpani Wasana Kumari, Research Assistant attached to the NIFS Condensed Matter Physics and Solid State Chemistry Projects has won the Best Poster Award at the 5th International Conference on Functional Materials and Devices held in Johor Bahru, Malaysia from 4th to 6th August 2015.

Prof. J Bandara received a position to serve as a member of the Editorial Board of the Progress in Photovoltic (Wiley Science) and Journal of Solar Energy (Hindawi) (2015).

Prof. J Bandara was the recipient of Turkish Government Research Fellowship in 2015.

Prof. L Jayasinghe received Alexander von Humboldt Research Fellowship to conduct research work at Jacobs University of Bremen, Germany, September-November, 2015.

Prof. MAKL Dissanayake received a Presidential Award for his scientific publications in the year 2013, on 18th November 2015.

Prof. MAKL Dissanayake served as the Consultant for Physics subject revision for the Eastern University of Sri Lanka (2015). This was funded and administered by the Higher Education for the Twentieth Century (HETC) Project of the UGC.

Prof. MAKL Dissanayake was an Invited Speaker at the 5th International Conference on Functional Materials and Devices organized by University of Malaya, Kuala Lumpur and held in Johor Bahru, Malaysia from 4th to 6th August 2015. He delivered an invited presentation on "*TiO_2 as a multi functional material"*

Prof. MAKL Dissanayake was awarded the General Research Committee (GRC) Award of the Sri Lanka Association for the Advancement of Science (SLAAS) in 2015. This award has been instituted by SLAAS to recognize Sri Lankan Scientists who have carried out exceptionally high quality research/pioneering research in Sri Lanka over a period of time and the award is given for the total research contribution of a scientist rather than for his/her contribution to a single research project.

Prof. MCM Iqbal received Presidential Award for Scientific Publications in the year 2013, on 18th November 2015.

Prof. ND Subasinghe received Presidential Award for Scientific Publications in the year 2013, on 18th November 2015.

Prof. NS Kumar delivered an invited lecture on Indigenous medicinal plants of Sri Lanka: A cultural heritage for development at the International Symposium on Science and Technology for Culture, Cambodia, May 15-17, 2015.

Prof. SA Kulasooriya delivered a Key Note Speech at 4th Annual Conference and Scientific Sessions, Sri Lankan Soceity for Microbiology, Kandy, 23rd October, 2015.

Prof. SP Benjamin Dr. GKR Senadeera received Presidential Award for his scientific publications in the year 2013, on 18th November 2015.

Prof. SP Benjamin was invited as a Key Note Speaker of the 3rd Conference of the Asian Society of Arachnology, Amravati, India

Grants Received

Research Grants

Dr. HWMAC Wijayasinghe (PI). NRC grant 15-007 Development of Sri Lankan graphite for rechargeable batteries, 2.4 million LKR (2015-2018)

Dr. Meththika Vithanage (Individual Grant). International Foundation for Science (IFS, Sweden) – W/5068-2 for the Hospital Wastewater monitoring research (2 years) 11195 USD=1,589,690 LKR (2015-2017)

Dr. Meththika Vithanage (PI). NRC Research grant for the Potential use of municipal solid waste derived biochar as a cover and permeable reactive barrier material for the remediation of volatile organic compounds in landfills– Grant number (NRC 15-24) 2,085,000 LKR (2015-2017)

Dr. RR Ratnayake (PI). Equipment grant by NSF for High Performance Liquid Chromatograph , 4.5 million LKR (2015-2016)

Dr. Suresh Benjamin (PI). NSF competitive research grant on Diversity of crab spiders of Sri Lanka based on morphology and DNA barcodes, 3,988,600 LKR (2015-2018)

Prof. L Jayasinghe (Collaborator). NSF grant on a comprehensive study on the anti-inflammatory and antimicrobial secondary metabolites in selected medicinal plants (2015-2018)

Prof. L. Jayasinghe (Collaborator) NSF grant on optimization of the processing parameters used in the traditional sesame oil production unit ('sekku') and in the screw-press oil expeller used in Sri Lanka (2015-2018)

Prof. MAKL Dissanayake (Co I). Grant from the Swedish Research Council for a collaborative research on dye sensitized solar cells, 12,000 USD=1,704,000 LKR (2015-2017)

Prof. MCM Iqbal and Dr. Meththika Vithanage (Co-I). NRC Reseach grant on historical trands in averages and extremes of rainfall, temperature and runoff data of Sri Lanka, 2 million LKR (2015-2017).

Prof. ND Subasinghe (PI). Grant from the NRC on Development of Thermoelectricity Devices, 3,283,750 LKR (2015-2018) Co-I Dr. HWMAC Wijayasinghe

Other Grants

Dr. CI Clayton received a travel grant to attend the 3rd Conference of Asian Society of Arachnology, Amravati, India. Nov 16-19, 2015.

Mr. CA Thotawatthage received a grant by the NSF OTPS and Swedish Research Council for a training at
Chalmers University, Sweden from June to
September, 2015.

Mr. Indika Herath received traveling and other expenses by the King Saud University to carry out research work from December, 2015 to February, 2016.

Mr. SMPR Kumarathilaka received traveling and other expenses by the King Saud University to carry out research work from December, 2015 to March, 2016.

Ms. HNM Sarangika received a grant by the NSF OTPS and University of Malaya for a training at Center of Ionics, University of Malaya, Malaysia from November to December, 2015.

Ms. Mindani I. Watawana received the ACN Travel Award to attend the 12th Asian Congress of Nutrition from 14 – 18 May 2015 in Yokohama, Japan.

Ms. UGSL Ranasinghe received a travel grant by National Science Foundation to attend the 3rd Conference of Asian Society of Arachnology, Amravati, India, Nov 16-19, 2015.

Ms. UGSL Ranasinghe received a travel grant to attend the 3rd Conference of Asian Society of Arachnology, Amravati, India. Nov 16-19, 2015.

Ms. UGSL Ranasinghe received partial bursary received to attend the 6th Student Conference on Conservation Science, Banglore, India.

Ms. SA Samaranayake received a training on Geothermal Systems at the United Nations University, Iceland for 7 months in 2015.

Ongoing Grants

Dr. HWMAC Wijayasinghe (Co I) received a grant for purification of Sri Lankan natural vein graphite for novel technological application by University Grant Commision for 2 years, 3,695,000 LKR (2014-2016).

Dr. Meththika Vithanage received a research grant for biochar for pesticide remediation, Ministry of
Technology and Research, Sri Lanka, 5,000,000 LKR
(2013-2016).

Dr. Meththika Vithanage received a research grant for the Quantitative assessment of potential human and ecosystem health risks imposed by atmospheric particulates in Kandy, Sri Lanka, by National Science Foundation, 3,900,000 LKR (2014-2016).

Dr. Meththika Vithanage received an equipment grant as a Core member of the JICA-JST grant for Solid
Waste Management with University of Peradeniya, 37,000,000 LKR
(2011-2016).

Dr. R Liyanage (Co-I) received a research grant for development of household food security models for poverty stricken areas of Sri Lanka by National Science Foundation for 3 years, 1,500,000 LKR (2013-2016).

Dr. RR Ratnayake received a grant for Government of Sri Lanka Presidential Scholarships for Foreign
Students - 2013/14 by Ministry of higher education, 1,910,000 LKR
(2013-2017).

Dr. RR Ratnayake received a research grant for biofuel and other microbial products from cellulosic biomass by National Research Council for 3 years, 5,945,000 LKR (2012-2015).

Dr. VY Waisundara received a research grant for in-vitro array guided identification of functional food from
Sri Lankan plant products by National Research Council for 3 years, 5,540,000 LKR (2014-2017).

Prof. J Bandara received a research grant on design of a biological and advanced oxidation technology reactor for oil water treatment by National Science Foundation for 3 years, 2,380,000 LKR (2014-2016).

Prof. MAKL Dissanayake received a research grant for optimization of Cds layer for efficiency enhancement in Cds/CdTe solar cells by National Science Foundation for 3 years, 2,800,000 LKR (2012-2015).

Prof. ND Subasinghe received a research grant for the estimation of subsurface extension of Eppawala apatite deposit and its parent rock using geophysical techniques by National Science Foundation for 3 years, 2,114,995 LKR (2012-2015).

Degrees Completed in 2015

- J Akilavasan, Ph.D., Different surface treatments of hydrothermally synthesied titania nanotubes for the improvement of the dye sensitized solar cells, University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. J Bandara** & Prof. RMG Rajapakse

- A Gannoruwa, M.Phil., Development of an IR active photocatalyst based on silver oxide and titanium dioxde nanocomposite, University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. J Bandara** & Prof. OA Ileperuma

- Anapayan, M.Sc., Synthesis and characterisation of Cu_2ZnSnS_4 thin films, University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. J. Bandara** & Prof. P. Samarasekara

- HMSKH Bandara, M.Phil, Isolation, structures and biological screening of metabolites from *Aspergillus niger* associated with *Musa* sp. University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. Lalith Jaysinghe** & **Prof. N Savitri Kumar**

- DS Jayaweera, M.Phil., Chemistry and Bioactivity of some edible seeds, University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. Lalith Jaysinghe** & Prof. BMR Bandara

- AAGW Alakolanga, M.Phil, Chemistry and Bioactivity studies of *Flacourtia inermis* and *Punica granatum.* University of Peradeniya, Sri Lanka, 2015. Supervisors: **Prof. N Savitri Kumar & Prof Lalith Jaysinghe**

- DK Weerasekara, M.Phil, Molecular Epidemiology studies of tuberculosis in three distinct population groups using optimized MIRU-VNTR typing system & spoligotyping. University of Peradeniya, Sri Lanka 2015. Supervisors: **Dr. DN Magana-Arachchi**

- MMSN Premathileke, Ph.D., grandis Soil carbon sequestration in Eucalyptusplantation forests of Sri Lanka along a chronosequence of forest age, University of Peradeniya, Sri Lanka, 2015. Supervisors: **Dr. RR Ratnayake & Prof. SA Kulasooriya**

- TB Nimalsiri, M.Phil, Characterization of thermal springs in Sri Lanka: A combined geological, geophysical and geochemical approach, University of PeradeniyaSupervisors: **Prof. ND Subasinghe**

- PB Jayathilake, M.Phil. (2015), Anodic oxidation of phenol in contaminated water on dimensionally stable anode. Post Graduate Institute of Science, University of Peradeniya.Supervisors: **Prof. ND Subasinghe**, Dr. N. Nanayakkara, A. Bandara

- Udari Siriwardana, M.Sc. in Environmental Science (2015), Characterization of dissolved organic carbon in Gohagoda landfill leachate. Post Graduate Institute of Science, University of Peradeniya.
  Supervisors: **Dr. Meththika Vithanage**, Prof. BFA Basnayake

- Niroshan Karunarathna, M.Sc. in Physics of Materials (2015), Synthesis and characterization of PAN based gel polymer electrolytes (GPE) and anode/cathode materials for Na-ion batteries, Post Graduate Institute of Science, University of Peradeniya.
  Supervisors: **Prof. M.A.K.L. Dissanayake & Dr. A. Wijayasinghe**

- C Jayathilake, M.Sc. (2015), Determinants of total phenolic content and antioxidant activity of Tricosanthes cucumerina areal parts, University of Peradeniya
  Supervisors: **Dr. R Liyanage,** Dr. N Rajapaksha

Supervision of Postgraduate Students

The postgraduate education is considered to be imperative as it provides the opportunities to build the research capabilities and enhance academic reputations whereas the postgraduate supervision is believed to be the cornerstone of an academic career. The success and quality of postgraduate education largely depends on effective and efficient supervision of postgraduate students. In this process, the supervisor is designated to facilitate the research. As the expectation of high quality postgraduate supervision is increasing, the supervisory role is becoming more challenging. Due to the excellence in supervision, instruments and hard work most postgraduate students are now reaching high merit research with outstanding quality publications. Postgraduate supervision provides better support for improving research, maintain high caliber in ethics, inspirate, timely completion, retention rate, student satisfaction, research environment and administrative support services. The role of the supervisor plays a crucial role to the overall satisfaction, retention and completion of postgraduate research degrees.

Here, we provide an excellent facilities and supervision to conduct high caliber postgraduate research. This caters the image of NIFS to be so fascinating.

Equipment Facilities & Developments

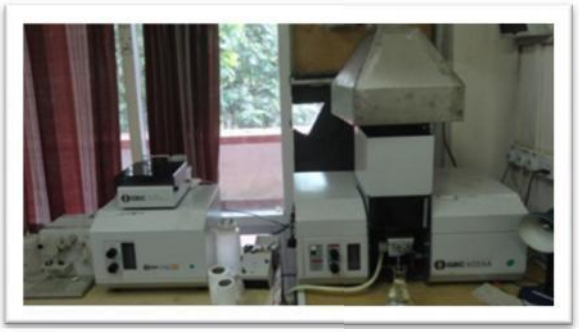
Newport AAA solar simulator

Gas Chromatoraph-Mass Spectroscopy

Spectrofluorometer

High Perfomance Liquid Chromatogrph

Gas Chromatograph

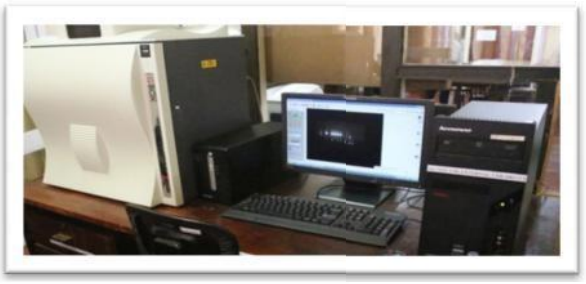


Atomic Absorption Spectrophotometer

Fuorier Transform Infra-Red Spectroscopy

TOC/TN Analyzer

Real Time PCR System



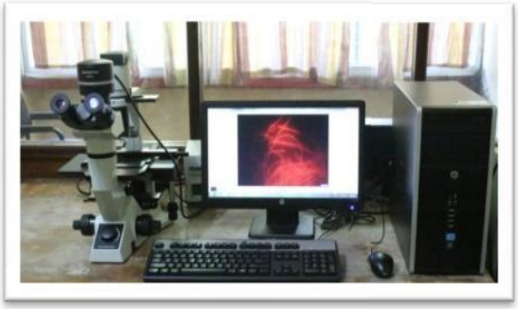
Gel Documentation System

Nabond nanofiber lectrospinning unit

Bentham Photovoltaic Characterisation

Anaerobic work station

Ion Chromatography



Inverted microscope

Microwave Digestion System

Resisitivity Instrument

Glove box

Kjeldahl System

CO_2 Incubator

Director's Office

Prof. S.H.P.P. Karunaratne
Director
Natinoal Institute of Fundamental Studies

From left: *Ms. Abesingha A.M.N.U, Ms. Senevirathne O.W.K, Ms. Jeewa Kasthuri M.D.,Mr. Malwewa M.P.D.K, Ms.Kapilarathne S.M.A.K*

All the activities related to administrative work of the National Institute of Fundamental Studies is facilitated by the Director's Office. The Director of the institute is the Chief Excutive Officer of the Institute. Prof. SHPP Karunaratne is the present Director of the NIFS. Personal Assistant to the Director is Ms. Jeewa Kasthuri and Ms. OWK Seneviratne is the Stenographer. Mr. MGDK Malwewa is the Office Aid. Two trainees, Ms. AMNU Abeysinghe and Ms. SMAK Kapilaratne are also working in the Director's Office.

Administration Division

Secretary

Dr. P.S.B. Wanduragala
Secretary to the Board
Secretary / National Institute of Fundamental Studies

From left, front: *Mr. Kumara AVAP, Mr. Dorakumbura DGK, Mr. Gunathilake AGST, Ms.Hettiarachchi TP, Ms. Weerasooriya RPM, Ms. Ilangakoon CLS, Ms. Ruwangalla NP, Ms. Ranasinghe C, Mr. Jayasinghe HADN, Mr. Somananda MAG.*
From left, back: *Mr. Gunasekara KBTB, Mr. Jayasekara DJMWP, Mr. Dissanayake DMDB, Mr. Gunawardene RSK, Mr. Gunathilaka DG, Mr. Dharmasena DG, Mr. Ariyawansha KM, Mr. Lal MA, Mr. Jayaweera ABGW, Mr. Aluthgedara AGJS*

Administration Division consists of the following sections:

- Maintenance
- Transport
- Reception
- Workshop

Duties and responsibilities entitled for the Administration Division

- Maintaining office procedures in Administration division
- Work related to recruitments
- Work related to contractual services
- Arranging Tender Board and Supplies Committee meetings and keeping minutes of them
- Calling Tenders and quotations for goods and services – local purchases
- Preparing Administrative report annually
- Supervision of NIFS visitor's rooms
- Maintaining Leave records of NIFS Staff

- Call for registration of suppliers annually
- Work related to construction and renovations
- Checking Overtime, fuel orders and contractual payments
- Man the reception desk and preparation of reports when necessary
- Directing visitors to appropriate contacts
- Maintenance of the Building (Electrical, water, Sanitary etc.)
- Insurance coverage of NIFS staff
- Maintain NIFS vehicles
- Providing transport facilities for the NIFS staff

Science Education and DisseminationUnit

Objectives

Foster the exchange of technical and scientific information for the scientific community and to promote the public understanding of science

Team

Left row from the bottom: *Ms. Herath NN, Dr. Thilakarathne CTK, Mr. Bandara GCK, Ms. Samarakoon KIK*
Right row from the bottom: *Mr. Piyathilaka SDPGP, Mr. Ekanayake VM*

Vidu Nena Hawula/Open Science Circle in Electronic Media (OSCEM)

Vidu Nena Hawula Science Message Service, known as OSCEM (Open Science Circle in Electronic Media)with the aim of improving the science literacy and scientific temperament of Sri Lankans.

OSCEM provides a daily Science message service via text messages (sms), e-mails and social networks such as facebook and twitter, a Science Blog in Sinhala and also a question and answer section. In addition, it provides an open forum for the subscribers to discuss their problems related to science behind day-to-day activities. This free service is provided on all weekdays except on government Holidays via text messages, e-mails and social networking **websites. Htt://viduneneahawula.com**

Vidu Nena Dasuna Youtube Channel-VND

The project – Vidu nena Dasuna Youtube Channel was launched with the aim of demonstrating science lessons and experiments to students in Sinhala and making science a simple and interesting subject for them. This project is being funded by the National Science Foundation since 2014 and currently consists of about 30 short videos covering different lessons & experiments included in the G.C.E. Ordinary Level and Advanced Level Syllabuses as well as other experiments that can be done by students themselves. www.youtube.com/user/IFSVND

Sinhala Science Web Site: Vidu Man Petha

The website "Vidu Man Petha" was launched with the intention of providing a reliable source of **scien**tific information in Sinhala. This website contains many scientific articles written by scientists, scientific games, interesting scientific experiments, a scientific glossary etc. Vidu Man Petha is the first ever Sinhala Science web site and has also won a juror's Special Merit award in the category of E-learning and Education at the e-Swabhimani National Best E-content award 2012 and is being continued successfully. http://www.vidumanpetha.com/

MASS project (Mobile Apps for Science Students)

MASS is the first ever known Mobile Application project that develops mobile apps in Sinhala to make Sri Lankan students learn science in a novel and more exciting manner. The first App of this project "Periodic Elements" which is created in the form of an interesting educational game, not only makes it easy for the students to memorize the properties of the chemical elements that are included in their syllabuses, but also gives them the opportunity to learn chemistry as a new & unique adventure.
https://play.google.com/store/apps/developer?id=Science+Education+%26+Dissemination+Unit+-+NIFS

Inculcating Science towards an Innovative Future (ISTIF)

National Institute of Fundamental tudies (NIFS) in collaboration with the Department of Education Central Province under the sponsorship of the United Nations Educational, Scientific and Cultural Organization (UNESCO), initiated a project nam d "Inculcate Scientific Methodology and novel teaching techniques for the level of Junior Secondary Education in Sri Lanka" in August 2013. Phase I:1160 science teachers of the central province were trained in 2013, Phase II: To analyse the ability of using scientific methodology and the questioning mind of the stude ts, examination was carried and answer scripts were corrected in 2015 and Phase III: The collected data will be analyzed using SPSS. The outcome of the project is expected to be published in electronic media including internet and the research journals in 2016.

School Science Programme (SSP)

The School Science Programme (SSP) is one of the most important annually conducted programme for the dissemination of science among the younger generation. The primary goal of the SSP is to expose young students to a few selected frontier areas of science and to provide an opportunity for them to interact directly with scientists actively engaged in research. One hundred and forty students from all over the country participated in the 42nd programme which was hold in year 2015.

In addition, Science camps, competitions, awareness programs, lab visits and exhibitions were organized to enhance the scientific literacy of the school community and the general public. To foster the exchange of technical and scientific information for the scientific community conferences, workshops, and different types of forums, seminars were organized jointly with the scientists of the institute. Training programmes were conducted for the undergraduate students on request by the Universities.

Recent Achievements:

Winner of Natioal award in the category of e-learning and education at the e-Swabhimani Natinal Best E-content Award 2014- *Open Scienc e Circle in Electronic Media*

Juror's Special Merit award in the category of E-learning and Education at thee-Swabhimani National Best E-co tent award 2012- "Vidu man petha" *Sinhala Sience Web Site (Vidumanpetha)*

Collaborative & Consultative Division

The Collaborative and Consultative Division (CCD) facilitates interactions of NIFS scientists and their projects with outside organizations. The principal objective is to take the findings of research studies beyond the institute so that their impacts are felt and utilized by the general public. During the year under review one project was completed, others are continuing and a few new projects were initiated and these are presented below:

a) Project completed:

Mass cultivation of *Spirulina platensis* (Gomont) Geitler in collaboration with Swayang Wattegedera
NIFS participants: Prof. S. A. Kulasooriya, A. M. H. A. K. Tennekoon (field assistant; Collaborator: Major
General (Retired) W. J. T. K. Fernando
This project was successfully completed and the final report was submitted to the National Science Foundation that awarded a grant for its partial funding. Our collaborator received a Technology Award of Excellence together with the NIFS as the collaborator at the NSF Awards 2015. According to General Fernando the technology has been transferred to the Agriculture Division of the Sri Lanka Army and they have now established large scale (5000 m^2) *Spirulina* outdoor cultivation ponds at Welikande.

b) Continuing projects:

Biofilm-Biofertilizers
NIFS participants: Prof. G. Seneviratne, Prof. S. A. Kulasooriya, Mr. E. M. H. G. S. Ekanayake (RA), Ms. P. Wijepala, Ms. S. Gunaratne
Collaborators: Mr. Saman Kumarasinghe (NBC) and Mr. Samuditha Kumarasinghe & Mr. Ananda Jayasekera (Lanka Biofertilizers PLC)
Extensive field testing of different crop specific biofilm-biofertilizers (BFBF) with plantation crops, cereals such as rice and maize, several vegetable crops, ornamental plants and fruits like strawberry are being conducted in collaboration with Lanka Biofertlizers (Pvt) Ltd, a subsidiary company of Nature's Beauty Creations PLC with which the 1st MoU was signed under the CCD.

Rhizobial Inoculants with food and forage legumes
NIFS participants: Prof. S. A. Kulasooriya, Mr. E. M. H. G. S. Ekanayake (RA), Mr. R. K. G. K. Kumara (Field Assistant), Ms. A. M. H. D. C. Abeyrathne (Lab Assistant)
Collaborators: Mr. H. M. A. C.Gunarathna, Mr. L. K. C. Prithiviraj, (Plenty Foods PLC), Mr. Sumith de Silva and Mr. Lakshman Dissanayae (Oasis Marketing PVT Limited), Ms. Niluka Gunathilleke, Research Officer, Department of Agriculture, Angunakolapelessa, Ms. N. H. Madhuka, S. Chitrapala, Research Officer, Department of Agriculture, Maha Illuppallema
Field testing of rhizobial inoculants with mung bean (*Vigna radiate* (L.) R. Wilczek*)* and ground nut (*Arachis hypogaea* L) are being carried out at Tissamaharama, Nugelayaya and Handungamuwa with outsource farmers of Plenty Foods PLC with the active participation of the field staff of the company. Field testing and demonstration trials of inoculating common bean or vegetable bean (*Phaseolus vulgaris* L.) were conducted in Balangoda, Maturata, Keppetipola and Hanguranketha. Further demonstration trials are in progress at Welimada and Balangoda areas with the active participation of staff from Oasis Marketing (Pvt) Limited. Field testing of rhizobial inoculation of the forage legume white clover (*Trifolium repens* L.) in collaboration with Ambewela Farm has given clear results to show that application of urea fertilizer to these cultivations can be replaced

completely by inoculation. Studies are in progress to develop seed inoculating techniques that could be adopted to apply treated seeds to large field areas using 'seed spreaders' attached to farm machinery.
Detailed results are presented under the Rhizobium Inoculant Research and Production Project.

From Left to Right: Mr. Kumara RKGK., Mr. Ekanayake EMHGS, Prof. Kulasooriya SA, Ms. Aberathne AHMCD, Ms.Ekanayake EMNW, Ms.Thathsarani JAN

Collaboration with the South Eastern University of Sri Lanka on Purification of Sri Lankan natural vein graphite for novel technological applications
NIFS investigator: Dr. Athula Wijayasinghe
The Research Assistant Mr. P.T.S. Hewatilake recruited through the UGC grant registered for a M.Phil. Degree at the PGIS, University of Peradeniya. He underwent a short training program conducted by the University of Moratuwa on graphite mining a Kahatagaha mines.

Collaboration with the Sri Lanka Institute of Nanotechnology (SLINTEC) on the Development of Sri Lankan natural vein graphite for nano-technological applications
NIFS investigator: Dr. Athula Wijayasinghe
The project is continuing.

Collaboration with the Department of Geology, University of Peradeniya
The project is continuing successfully and a few publications and conference presentations were made.
NIFS investigator: Prof. N.D. Subasinghe

c) New projects
Collaboration with the Uwa Wellessa University (UWUSL) on the Development of next generation advanced materials for future applications including nano-technology
NIFS investigator: Dr. Athula Wijayasinghe
Material preparation on the development of electrolyte materials for Na-ion rechargeable batteries is in progress under the M.Sc. program of the NIFS Research Assitant. Preliminary work on the development of Sri Lankan montmorillonite for nano technological applications was initiated.

Collaboration with Rajini Farm, Piliyandala to introduce biofertilizers and minimize the application of chemical fertilizers and other agro-chemicals to their crops and move towards organic farming
NIFS investigator: Prof. S.A. Kulasooriya, Prof. G. Seneviratne
A memorandum of understanding was signed in December and a preliminary visit to the Farm was paid by a NIFS team. A field experimental design was prepared and instructions were given to lay out experimental treatment plots. Field trials will commence once the field plots are prepared.

Colombo Office

With the Parliamentary Act No. 55 of 1981, the Institute of Fundamental Studies was established as the only research Institute engaged in fundamental research in Sri Lanka.

In 1985 on December 5th the main laboratories were installed at Hantana, Kandy and the objectives of the institute are being fulfilled by the following activities by the Colombo office.

- Co-ordination of all administration and research work was done through the Colombo office with the ministry.
- Organizing of seminars, lectures & conferences
- The Colombo office has been providing accommodation for the scientists who attend for various matters in Colombo.
- Some of the laboratory items, chemicals and other equipment which are ordered are being kept at the Colombo office until they are transported to the Kandy main branch. Also any samples to be sent abroad or which has been imported and customs related formalities are arranged by the Colombo office.

IFS- Sam Popham Arboretum

When you travel from Dambula towards Anuradhapura on the A9 road and proceed about two and half kilometers along the Kandalama road you will encounter the NIFS- Sam Popham Arboretum (NIFS-SPA) on the right hand side. This unique site was owned by an Englishman, Mr. F. H. (Sam) Popham, who gifted it to NIFS (then IFS) in 1989 to carry out research and educational activities.

Mr. Popham was originally a Naval Officer who later became a Tea Planter. His last occupation was the administrator of the Revision of the Flora of Ceylon project funded by the Smithsonian

Institution of Washington, DC. That project was based at the National Herbarium of Royal Botanic Gardens, Peradeniya.

Original site bought by Popham in 1963 was a seven and half acre-scrub jungle. Popham allowed the indigenous tree saplings in the site to emerge and establish by removing the 'weedy' shrubs around them. Consequently, the scrub jungle was turned into a dry zone woodland with a closed canopy.

After taking over the land in 1989, NIFS bought another 27 acres of adjoining scrubland to expand the arboretum. Popham's method of 'assisted regeneration' was practiced to convert that land also into a dense woodland.

Currently, NIFS-SPA is visited by many local and overseas researchers for educational purposes and ecological research. It is also a popular tourist destination owing to the presence of unique fauna such as Slender Loris, Pangolin and a rich vegetation consisting of over 200 species of trees.

Since 2005 the management of NIFS-SPA is carried out by Ruk Rakaganno (the Tree Society).

Internal Audit

The Internal Audit Division is functioning under the direct supervision and guidance of the Director.

From Left to Right: Ms. Jayasooriya SN, Gunasena, CO

The Division is responsible for independent and objective reviews and assessment of the Institute's activities, operations, financial systems and internal controls adhering to Laws, Circulars, Financial Regulations and provisions of the Establishments Code and to make observations and recommendations to the Senior Management.

When dealing with internal audit functions of the institution, special attention is paid for the below functions as mentioned in F.R. 133,

- Examine whether the internal inspection and administrative system implemented within institution to prevent frauds and malpractices are successful in its planning and implementation.
- Ascertain the accuracy of the accounting and other records and ensure that the accounting methods used are effective for the preparation of financial statement.
- Evaluating the quality of performance demonstrated by the staff in the performance of their duties and responsibilities.
- Verifying how far the assets belonging to institute have been protected from any kind of damages.
- Examine whether the provisions of the circulars issued from time to time by the Ministry in charge of the subject of public administration and the General Treasury, establishments code, financial regulations of the government and other supplementary instructions are properly followed
- Conducting special investigation wherever necessary.
- Following the guide lines and directions given from time to time by the Department of Management Audit, conducting the meetings of audit & management committee quarterly and taking follow up actions to verify the progress in the implementation of decisions taken at those meetings.

Accounts Division

<u>From Left to Right:</u> Mr. Weerasooriya BJ, Ms. Nissanka MK, Ms. Gamlath TP, Ms. Nishshanka LNMDSK, Ms. Samarakkody PSS, Ms. Rathnayake RMVP, Ms. PalliyaGuruge MP, Mr. Ariyaratne, MP, Mr. Perera MAP, Mr. Keshan MKD

This division consists of the Deputy Accountant (supervisor-in-charge), an Accounts Officer, three Senior Staff Assistants (Clerks, Book-Keeper), a Staff Assistant (Stores Keeper), three Management Assistants and an Office Machine Operator. The division provides support for finance and accounting services at the institute in the following areas:

- **Funding Sources:** Recording of cash received from the General Treasury and other external local and foreign sources.
- **Payroll:** Preparation of salaries based on personal information, taxes and other deductions and allowances.
- **Personal Provident Fund:** Maintenance of the contribution of Employees Provident Fund by keeping cards and records separately for individual employees, investing & monitoring fixed deposits and withholding tax.
- **Staff Loan:** Management of the EPF and concessionary loan schemes, and maintenance of relevant records.
- **Cash payments:** Payment of a wide variety of purchases, taxes;upkeep all supporting documents and files to assure the amount to be paid is correct and in compliance with relevant government rulesand regulations.
- **Budgeting:** Estimating the sources and expenditure for the period; this also serves a number of important purposes such as monitoring and controlling the finances of the institute.
- **Procurement & Inventory:** Keeping track of all purchases such as stationery, hardware & general items, and local inventory items.
- **Final Accounts Statement:** Preparation of comprehensive final accounts and statements in compliance with Sri Lanka public accounting Standard and accepted accounting principles.
- **Maintenance of Financial Records:** Ensure proper maintenance and updating of accounting records and preparation of financial reports upon request

Procurement & Laboratory Stores

Our Objectives

The Procurement and Laboratory Stores is committed to providing the necessary resources to achieve the
goals of the National Institute of Fundamental Studies.

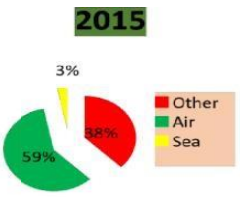
Our Team

<u>From Left to Right:</u> Ms. J. P. G. H. T. Jayalath (Trainee), Ms. E. M. G. W. D. Edirisooriya (Trainee), Ms. H. M. M. H. K. Herath (Trainee), Eng Ms. W. D. S. P. Perera (Laboratory Manager), Ms. D. M. K. L. Kumari (Senior Staff Technical Officer), Ms. G. W. R. P. Chandrakanthi (Senior Staff Assistant/Stenographer)

Our Services

- Foreign and local purchasing for all items including Laboratory Equipment, Chemical, Glassware and Consumables

- Handling Chemical and Glassware Stores and implementing and monitoring the Bin card system
- Handling Customs procedures for all import and export items



- Maintains a record of assets owned by Institute. The system includes a complete description of the asset; Its acquisition date and cost, location, condition and other information.

Technical Staff

The mission of the Technical staff of the National Institute of Fundamental Studies is to support the research activities when analytical and technical expertise are needed.

The expertise of the Technical Staff is useful for the scientists to carry out the research. They guide the undergraduates and post graduates to operate the instruments for research.

The technical staff also support computer and system administration of the institute, and also handle orders and manage supplies of chemicals and glassware. Thus, they are key to achieving the objectives of the institute.

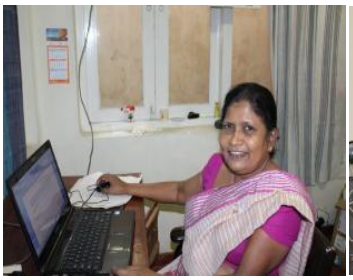
Further, they conduct sample analysis for other institutes. Some have research publications in referred journals and received several presidential awards.

The role of the Technical officer at IFS

programming, operation and maintenance of servers, computers and network system of the entire institute

- The maintenance and operation of the PABX system and telephone network of the institute
- The maintenance and supervision of the electrical installation, switchgears, generator and the Central UPS system in the institute
- Maintaining the chemical, glassware store and inventory of the institute
- Instrument, sample preparation and analysis
- Maintenance, calibration and operation of analytical equipment.
- Maintenance and operation of the automated attendance system for the whole staff
- Web designing, providing technical support to school science programs, conferences, seminars and workshops
- General maintenance of the analytical instrument range in the institute
- Field sample collection, preservation
- Ethics of laboratory discipline in line with GLP

Other miscellaneous services provided include participation in committees like Tender Board, supplies Committee, Instrument Committee, Salaries committee, Technical Evaluation Committees, Computer committee, Web committee, Interview panels and also has represented the Institute in various occasions.



The technical personnel have contributed in setting the specifications by evaluating the analytical requirement from various basic to high - end instrumentation by maintaining and living up to the standards of the institute.

N.P.Athukorala
D. Aluthpatabendhi
A.K. Pathirana
S.S.K.Skalasooriya
A.B. Herath
R.C.K. Karunarathna
R.S.M. Perera
M.D.K. Lakshmi
K umari
D.S. Jayaweera
S. Opatha
I .Thmpala
W.G. Jayasekara Banda
G.C.K.S. Bandara
V.M. Ekanayeke
R.B. Weerakoon
M.N.B. Kulathunga

Library

The NIFS library was established in 1985 with a small collection of books and journals donated by Prof. Cyril Ponnamperuma, well-wishers and the Asia Foundation. Since then it now has a modest collection of over 6669 books and about 120 Journal titles covering the life, physical and athematical sciences as well as the philosophy and history of science the fundamental text books, monographs and edited volumes.

Objective

The Main objective of the library is to collect, compile, retrieve and disseminate information related to our research for the benefit of NIFS Research staff and other interested parties.

During the last year, 84 new books were added to the collection, consisting of 58 purchased books, and 26 books received on complimentary basis. A large number of periodicals, newsletters, annual reports from local and foreign institutions were also received on a complimentary or an exchange basis, and the library subscribed to 14 journals related to our research

Library Services

NIFS Library provided services on reference and lending, document delivery, resource sharing, inter-library
loan facility, photocopying facility, information alert services and sourcing web based electronic journals and articles. The Library also provides access to the OARE data base through subscriptions. This provides online access to scientific journals. Currently 40 such journals are available online through this scheme.

Digitization of institute publications

National Science Foundation undertook digitization of our institute's publications starting from 2013-12-21. The aim of the project was to establish an institutional e-repository and provide quick enhanced online access to institute publications. About 60,000 pages were electronically scanned to upload to server (http://ifs.nsf.ac.lk/).

Conferences and Seminar

- Institutional Repository of the NIFS: A Seminar with demonstration on the National Digitization was organized by the NIFS Library. Lectures were conducted by Mrs. Sunethra Perera, Head NSF Library and Resource Centre, on 03rd August ,2015.
- A workshop on Dewey Decimal Classification System was organized by the National Library and Documentation Center on 11th August 2015
- Progress review meeting of "National Digitization Project", National Science Foundation, was held on 22 September 2015

Other Activities

- A series of lectures on Improving reading habits in children and intorducton of library system was conducted at the following places
- Palath Paalana Sathiya, A special lecture was delivered on education and library development day organized by Kandy Municipal Council, on 10th September, 2015
- Janaraja Maha Vidyalaya, Katugastota, Kandy, on 15th October, 2015
- Hillwood College, Kandy, 29th October, 2015

<u>From Left to Right:</u> Ms.Tilakarathne TCPK, Ms.Witharana RM, Ms. Sumanarathne HMTL

Staff of the NIFS 2015

Director : Prof. C.B.Dissanayake upto 30.09.2015
Prof. S.H.P.P.Karunaratne w.e.f. 01.10.2015
Secretary : Dr. P.S.B.Wanduragala

Research Staff

Senior Research Professor
Prof. A.Nanayakkara

Research Professors

Prof. J.M.S.Bandara
Prof. M.A.K.L.Dissanayake
Prof. U.L.B.Jayasinghe
Prof. N.S.Kumar up to 02.08.2015
Prof. P.R.G.Seneviratne

Associate Research Professors

Prof. S.P.Benjamin
Prof. M.C.M.Iqbal
Prof. N.D.Subasinghe

Senior Research Fellow

Dr. D.N.Magana-Arachchi
Dr. R.R.Ratnayake
Dr. M.S.Vithanage

Research Fellow

Dr. R.Liayanage
Dr. H.W.M.A.C.Wijayasinghe
Dr. V.Y.Waisundara

Visiting Research Professors

Prof. S.A.Kulasooriya
Prof. N.S.Kumar w.e.f. 03.08.2015

Visiting Associate Research Professor
Prof. G.K.R. Senadeera

Visiting Senior Scientist
Dr. W.P.J. Dittus

Research Assistants Gr.I

Mr. A.Manjceevan
Mr. C.A.Thotawattage
Mr. W.W.M.A.B.Medawatte
Mr. P.H.M.I.D.K.Herath
Mr. T.B.Nimalsiri
Ms. S.M.M.P.K.Seneviratne

Research Assistant Gr.II

Mr. E.M.H.G.S.Ekanayake
Mr. S.M.P.R.Kumarathilake Mr.
K.M.S.D.B.Kulatunga
Ms. C.L.Kehelpannala
Ms. R.P.S.K.Rajapaksha
Ms. U.G.S.L.Ranasinghe
Ms. T.P.Keerthiratne
Ms. J.M.K.W.Kumari
Mr. G.R.N.Ratnayake
Ms. D.Thanabalasingham
Mr. M.M.Qader
Ms. W.T.Awanthi
Ms. S.A.Samaranayake
Mr. K.P.V.B.Kobbekaduwa
Mr. A.M.J.S.Weerasinghe
Mr. R.I.C.N.Karunaratne
Ms. M.I.Watawana
Ms. N.N.Jayawardena
Ms. R.M.G.C.S.K.Jayathilake
Mr. D.M.V.Y.S.Bandara
Ms. P.C.Wijepala
Ms R.Vishvanathan
Mr. K.N.L.De Silva
Ms. R.M.N.M.Ratnayake
Ms. D.M.D.M.Dissanayake
Ms. H.M.S.Wasana
Ms. E.G.C.K.Priyadarshika
Mr. D.M.T.U.Bandara
Ms. M.Kanesharatnam
Mr. S.Sayanthooran
Ms. H.K.S.N.S.Gunaratne
Mr. G.D.K.Heshan
Mr. M.Kathigamanathan
Ms. D.K.Weerasekara
Ms. R.M.A.S.Ratnayake
Ms. H.A.P.P. B. Jayathilake

Technical Staff
Chief Technical Officers

Mr. M.N.B.Kulathunga
Mr. W.M.R.B.Weerakoon
Ms. I.Tumpale
Mr. N.P.Athukorale
Mr. W.G.Jayasekara Banda
Mr. S.Opatha
Mr. H.M.A.B.Herath
Ms. S.S.K.Sakalasooriya
Mr. D.S.Jayaweera
Ms. R.K.C.Karunaratne
Mr. A.K.Pathirana
Ms. D.Aluthpatabendi
Ms. R.S.M.Perera

Director's Office

Ms. M.D. Jeewa Kasthuri	Personal Secretary to the Director
Ms. O.W.K.Seneviratne	Stenographer Gr.II
Mr. M.P.D.K.Malwewa	Office Aide

Internal Audit Division

Ms. W.S.N.F.Jayasuriya	Internal Audit Officer
Ms. C.O.Gunasena	Management Assistant Gr.III

Library

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

Science Education & Dissemination Unit

Dr. C.T.K.Tilakaratne	Coordinator
Ms. K.I.K.Samarakoon	Stenographer Gr.II
Mr. V.M.Ekanayake	Technical Officer Gr.III
Mr.G.C.K.S.Bandara	Technical Officer Gr.III
Mr. S.D.P.G.P.Piyathilake	Communication & Media Officer
Ms. H.M.G.N.N.Herath	Management Assistant Gr.III

Colombo Office

Ms. M.C.Rajapakse	Coordinator cum Scientific Officer – on leave
Mr. A.D.Gunawardena	KaryalaKaryaSahayake/Driver

Accounts Division

Ms. P.S.S.Samarakkody	Deputy Accountant
Ms. L.N.M.D.S.K.Nishshanka	Accounts Officer
Ms. M.K.Nissanka	Senior Staff Assistant – Book Keeper
Ms. M.P.PalliyaGuruge	Senior Staff Assistant – Clerical
Ms. R.M.V.P.Ratnayake	Senior Staff Assistant – Clerical
Mr. G.Ariyaratne	Staff Assistant – Store Keeping
Ms. T.P.Gamalath	Management Assistant Gr.III Mr.
M.K.D.Keshan	Management Assistant Gr.III Mr.
B.J.Weerasooriya	Management Assistant Gr.III Mr.
M.A.P.Perera	Office Machine Operator

Procurement & Lab Stores Division

Ms. W.D.S.P.Perera	Laboratory Manager
Ms. D.M.K.Lakshmi Kumari	Chief Technical Officer
Ms. G.W.R.P.Chandrakanthi	Senior Staff Assistant – Stenographer

Administration Division

Ms. R.P.M.Weerasooriya	Senior Staff Assist ant –Clerical/ Actg.Administrative Officer
Ms. T.P.Hettiarachchi	Senior Staff Assistant – Stenographer
Ms. C.L.S.Illangakoon	Senior Staff Assistant – Stenographer
Ms. C.Ranasinghe	Staff Assistant –Stenographer
Mr. D.G.Gunathilake	Record Keeper Gr.I
Mr. A.G.S.T.Gunathilake	Management Assistant Gr.III
Mr. A.B.G.W.Jayaweera	Driver – Special Grade
Mr. M.A.G.Somananda	Driver – Special Grade
Mr. K.M.Ariyawansa	Driver - Special Grade
Mr. G.A.R.Basnayake	Driver - Special Grade
Mr. R.S.K.Gunawardena	Driver - Special Grade
Mr. K.G.T.B.Gunasekara	Driver Gr.I
Mr. H.A.D.N.Jayasinghe	Driver Gr.III Mr.
D.M.D.B.Dissanayake	Driver Gr.III
Mr. D.J.M.W.P.Jayasekara	Machanist – Special Grade
Mr. A.V.A.P.Kumara	Machanist Gr.I
Mr. M.A.Lal	Laboratory Attendant – Special Grade
Mr. R.B.Hapukotuwa	Laboratory Attendant – Special Grade
Mr. G.D.Dharmasena	Electrician Gr.II
Mr. D.G.K.Dorakumbura	Mason Gr.I

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES - SRI LANKA

SIGNIFICANT ACCOUNTING POLICIES - YEAR ENDED 31ST DECEMBER 2015

(1) GENERAL ACCOUNTING POLICIES

1.1 The financial statements have been prepared on the basis of historical costs in accordance with the Srilanka Public Sector Accounting Standards for the accrual basis accounting and no adjustments have been made for inflatory factors affecting these accounts, instead of Motor Vehicle re-valuation according to the special Re-valuation committee.

1.2 Similarly Laboratory Equipment, Machinery Tools & Implements, Refrigerators, Air Conditioners, Communication Equipment, Office & Miscellaneous Equipment, Sports Items are re- valued by the Special Re-valuation Committee and there is no inflator factors affecting to the accounts.

1.3 The value of Revaluation of Fixed Asset in 2011 and the value of Motor Vehicle in 2015 have been shown as Revaluation Reserve being adjusted by Institute Fund Account.

1.4 Previous year figures and phrases have been re-arranged wherever necessary to conform 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 effected. 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 2.2.2

2.2.2 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 purchased to the date of disposal.

2.2.3 The Accumulated depreciation has been corrected due on 31st December 2015 to meet the Fixed Assets of the Institution by that date.

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 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 I.F.S. PROVIDENT FUND

Members' fund as at 31st December 2015 are shown under specified funds in the Statement of Financial Position.

4. REVENUE RECEIPTS

4.1 GOVERNMENT GRANT

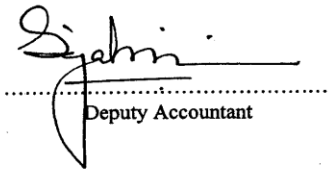
Government grant received during the year under review towards the recurrent expenditure has been charged to the Statement of Financial Performance for the year. Total revenue and capital funds of the Institute accumulated from the previous years have been shown as Institute funds in the Statement of 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 cost 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 un-utilized specified grant balances have been shown as in the Research Grant Fund under specified fund in the Statement of Financial Position.



Deputy Accountant

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

SRI LANKA

STATEMENT OF FINANCIAL POSITION AS AT 31.12.2015

	NOTE	SLRs 2015	(RESTATED) SLRs 2014
ASSETS			
CURRENT ASSETS			
CASH AND BANK BALANCES	1	145,116,051.14	63,088,741
DEPOSITS PREPAYMENTS & ADVANCES	2	20,646,967.92	6,454,933
DISPOSABLE OF FIXED ASSETS		24,915,351.37	24,915,351
FESTIVAL ADVANCE FUND INVESTMENT		300,000.00	256,000
CONSUMPTION LOAN FUND INVESTMENT		225,398.09	289,668
INTEREST RECEIVABLE FOR FIXED DEPOSITS		3,195,205.54	2,840,452
STAFF CONSUMPTION LOAN	3	4,277,244.00	4,029,005
DEBTORS AND OTHER RECEIVABLE	4	98,361.66	261,639
STOCKS	5	2,169,014.05	2,283,904
		200,943,593.77	**104,419,693**
NON-CURRENT ASSETS			
WORK IN PROGRESS (NEW BUILDING)		142,920,000.00	142,920,000
PRELIMINARY EXPENSES FOR CONSTRUCTION		20,000.00	-
PROVIDENT FUND INVESTMENT	6	65,342,775.00	50,694,277
TRAINING CAPACITY		882,197.40	837,697
PROPERTY, PLANT AND EQUIPMENT	7	261,035,316.49	253,379,402
MAPPING REPORT		1,097,477.65	1,097,478
MODEL OF LAND		37,500.00	37,500
		471,335,266.54	**448,966,354**
TOTAL ASSTES		**672,278,860.31**	**553,386,047**
LIABILITIES			
CURRENT LIABILITIES			
ACCOUNTS PAYABLE	8	4,556,926.86	1,131,942
ACCRUED EXPENSES	9	2,034,167.90	1,952,248
		6,591,094.76	**3,084,190**
NON CURRENT LIABILITIES			
SPECIFIED FUNDS & GRANTS	10	88,848,478.94	76,949,751
DIFFERED LIABILITIES	11	19,910,287.50	18,970,558
		108,758,766.44	**95,920,309**
TOTAL LIABILITIES		**115,349,861.20**	**99,004,499**
NET ASSETS		**556,928,999.11**	**454,381,548**
NET ASSETS/EQUITY			
CAPITAL FUND - SPENT	12	417,752,142.26	374,327,140
- UNSPENT	12	114,070,275.11	21,494,278
PRESIDENT'S FUND - SPENT		7,078,501.15	7,078,501
ASSET REVALUATION RESERVE		131,630,743.37	122,463,619
INSTITUTE FUND		(113,602,662.78)	(70,981,990)
TOTAL NET ASSETS/EQUITY		**556,928,999.11**	**454,381,548**

Director Secretary Deputy Accountant

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

SRI LANKA

STATEMENT OF FINANCIAL PERFORMANCE FOR THE YEAR ENDED 31.12.2015

	NOTE	SLRs 2015	(RESTATED) SLRs 2014
OPERATING REVENUE			
RECURRENT GRANT		154,000,000.00	144,441,000
OTHER INCOME	13	11,305,817.10	12,109,500
		165,305,817.10	**156,550,500**
EXPENDITURE			
PERSONAL EMOLUMENTS	14	113,462,034.50	87,509,138
TRAVELLING	15	1,163,172.70	1,027,681
SUPPLIERS & CONSUMABLE	16	16,205,267.91	16,504,888
MAINTENANCE	17	7,206,307.50	7,637,019
CONTRACTUAL SERVICES	18	17,208,167.10	16,241,010
DEPRECIATION		40,615,891.16	37,271,388
OTHER EXPENSES	19	19,125,725.33	20,949,649
TOTAL OPERATING EXPENSES		**214,986,566.20**	**187,140,773**
DEFICIT FROM OPERATING ACTIVITIES		(49,680,749.10)	(30,590,273)
FINANCE COST		-	- -
NET DEFICIT FOR THE YEAR		**(49,680,749.10)**	**(30,590,273)**

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES

SRI LANKA

STATEMENT OF FINANCIAL PERFORMANCE FOR THE YEAR ENDED 31.12.2015

	NOTE	SLRs 2015	(RESTATED) SLRs 2014
OPERATING REVENUE			
RECURRENT GRANT		154,000,000.00	144,441,000
OTHER INCOME	13	11,305,817.10	12,109,500
		165,305,817.10	**156,550,500**
EXPENDITURE			
PERSONAL EMOLUMENTS	14	113,462,034.50	87,509,138
TRAVELLING	15	1,163,172.70	1,027,681
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TOTAL OPERATING EXPENSES		**214,986,566.20**	**187,140,773**
DEFICIT FROM OPERATING ACTIVITIES		(49,680,749.10)	(30,590,273)
FINANCE COST		-	- -
NET DEFICIT FOR THE YEAR		**(49,680,749.10)**	**(30,590,273)**

NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES
SRI LANKA

STATEMENT OF CHANGES IN NET ASSETS/EQUITY FOR THE YEAR ENDED 31.12.2015

ATTRIBUTABLE TO OWNERS OF THE CONTROLLING ENTITY					
	CONTRIBUTED CAPITAL	PRESIDENT FUND	REVALUVATION SURPLUS	INSTITUTE FUND	TOTAL NET ASSEST/EQUITY
BALANCEAS AT 31 DECEMBER 2014	395,821,417.37	7,078,501.15	122,463,619.32	(63,443,382.23)	461,920,155.61
ADD: FUND ADJUSTMENT IN LAST YEAR				1,917,870.00	1,917,870.00
	395,821,417.37	7,078,501.15	122,463,619.32	(61,525,512.23)	463,838,025.61
ADJUSTMENTS : PRIOR YEAR ADJUSTMENTS				(9,456,478.64)	(9,456,478.64)
BALANCEAS AT 31 DECEMBER 2015 (RESTATED)	395,821,417.37	7,078,501.15	122,463,619.32	(70,981,990.87)	454,381,546.97
REVALUATION DEFICIT/SURPLUS			9,167,124.05		9,167,124.05
FIXED ASSET PURCHASE FROM GRANT	-	-	-	2,851,809.73	2,851,809.73
ADDITION DURING THE YEAR TO INSTITUTE FUND	-	-	-	4,289,648.75	4,289,648.75
DEFICIT FROM OPERATING ACTIVITIES	-	-	-	(49,680,749.10)	(49,680,749.10)
DESPOSAL OF FIXED ASSETS	-	-	-	(81,381.29)	(81,381.29)
CAPITAL FUNDS RECEIVED FROM GOVERNMENT & OTHER SOURCES	136,001,000.00	-	-	-	136,001,000.00
BALANCE AS AT 31 DECEMBER 2015	**531,822,417.37**	**7,078,501.15**	**131,630,743.37**	**(113,602,662.78)**	**556,928,999.11**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 1		
CASH AND BANK BALANCES		
National Savings Bank, Kandy - EPF Account A/C No 1-0015-01-02989	2,027,627.70	5,765,450
National Savings Bank, Kandy - Research Fund A/C No 1-0015-01-03152	67,096.54	63,831
National Savings Bank, Kandy -Consumption Loan Fund A/C No 1-0015-109-1808	225,398.09	289,668
Bank of Ceylon, Kandy, -A/C NO RFC/162747	7,698,961.68	5,357,148
Bank of Ceylon, Kandy, A/C No 32794	1,966,196.94	2,000,381
Bank of Ceylon, Kandy, A/C No 32795	19,025,056.95	18,390,670
Bank of Ceylon, Kandy, A/C No 32779	114,105,713.24	31,221,593
	145,116,051.14	**63,088,741**
NOTE 2		
DEPOSITS PREPAYMENTS & ADVANCES		
Refundable Deposit (Note 2A)	441,100.00	417,100
Prepayment (Note 2B)	1,830,002.19	1,369,257
Prepayments & Advance Foreign (Note 2C)	11,016,644.68	1,306,065
Prepayments & Advance Letter of Credit (Note 2D)	6,623,888.42	1,507,624
Advance to Suppliers & Others (Note 2E)	105,439.76	63,096
Advance of Stand - Structural Geology	4,960.00	4,960
Advance of Director, Building Dep.	614,980.37	1,782,831
Advance of Hydraulic Jack	4,000.00	4,000
New Rack Stores	5,952.50	-
	20,646,967.92	**6,454,933**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 2A		
REFUNDABLE DEPOSIT		
Ceylon Electricity Board	275,000.00	275,000
Sri Lanka Telecom	5,000.00	5,000
Kandy Municipal Council	20,000.00	20,000
Ceylon Oxygen Ltd.	56,100.00	32,100
Colombo Gas Company	2,000.00	2,000
Lanka Internet Service	1,000.00	1,000
Kandy Tyre Rebuilding Co.	50,000.00	50,000
D.A. Epa & Sons (Pvt) Ltd	3,750.00	3,750
C.I.S.I.L.	15,000.00	15,000
Shell Gas Lanka Limited	3,750.00	3,750
MTN Network Pvt. Ltd.	2,500.00	2,500
Dialog Telecom Package	4,000.00	4,000
America Preime Water Systems	3,000.00	3,000
	441,100.00	**417,100**
NOTE 2B		
PREPAYMENT		
American Chemical Society	171,016.44	116,497
American Physical Society	-	26,176
American Society For Microbiology	75,023.50	61,118
Current Science Association Bengal	43,400.00	-
The American Archeological Society	15,792.31	13,152
Chief Post Master Kandy	5,000.00	5,000
Dr. C.T.K. Thilakarathne	22,912.71	-
Institute of Food Technologies	6,551.25	-
Director General of Custome	274,002.00	
Metropolitan Office Pvt Ltd	-	4,896
Macmillan Subscriptions Ltd	9,876.76	10,587
National Geographic Society	8,652.49	8,173
New Scientist	16,993.23	17,193
Portland Customer Service	8,782.47	17,565
S.B. Freight Services	50,221.34	630
Scientific America	6,926.27	6,480
JohnKeells Office Automation (Pvt.) Ltd.	22,825.88	19,119
Oxford Journal	10,038.86	9,630
Sri lanka insurance	671,314.62	581,110
Society for Conservation Biology	-	15,280
Director General Government Information	-	576
Society for the Study of Evaluation	14,448.75	-
Soil Science Society of America	31,878.75	-
ACS Member Service	-	41,079
American Association for Advance of Science	14,834.34	20,777
Material Research Society	12,004.98	16,958
World Health Organization	223,946.57	205,061
Philosophy NOW	-	4,730
Elsevier Ltd Journal	71,241.50	63,426

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
John Willey & Sons Ltd	-	9,630
British Ecology Society	-	17,234
New York Acedemy of Science	23,163.75	21,265
Acoustical Society of America	-	15,945
The Union	19,153.42	21,380
Society for Free Radical Biology	-	3,975
Society for Ecology Restoration	-	14,615
	1,830,002.19	**1,369,257**

NOTE 2C

ADVANCES (FOREIGN PURCHASE)

Springer Customer Service Center	44,642.52	-
Amersham Life Science Ltd	1,546.27	1,546
Bacheman California	11,873.65	11,873
Bacton Dickinson Holdings	682,249.33	-
Chicago Distribution	6,420.97	-
New Port Corporation	3,246,782.38	-
Elsevier Science	61,008.50	61,009
Fisher Scientific UK	488,398.50	-
LC Technology Solution Inc	5,059,637.21	-
Fluka Chemical	34,771.47	34,771
Phatpocket Ltd	6,745.37	126,071
Hopkins Fulfillment Serving	20,795.40	-
Kluwer Academic	47,733.25	47,733
John Willey & Sons Singappore Pvt Ltd	22,318.02	-
M.J. Patterson (Scientific) Ltd	20,447.53	20,448
Sigma Aldrich	32,616.72	32,617
Milestone Sri	-	285,255
Inter World Highway LLC	100,004.40	-
Ven India Imports & Export	75,422.58	1,168
VWR International Ltd	219,946.62	68,562
Wageningen Agricultural University Netherlands	9,727.20	9,727
Macrogen Inc	411,015.71	165,320
Intragrated DNA Technologies	-	40,947
Electron Microscopy Sciences	-	88,649
Brookfield Engineering	-	310,369
Thorlabs Inc	257,891.54	-
Thomes Scientific	154,649.54	-
	11,016,644.68	**1,306,065**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 2D		
PREPAYMENTS & ADVANCES (LETTER OF CREDIT)		
Advanced Geo Sciences Inc KN/SIL/2015/27	5,238,053.00	-
Agilent Technology Singpore (Sales) KN/SIL/2015/43	1,385,835.42	-
New Port Corporation FP/14/41 - BTD/M064468	-	1,507,624
	6,623,888.42	**1,507,624**
NOTE 2E		
ADVANCES TO SUPPLIERS & OTHERS		
Genetech	-	7,800
Sri Lanka Telecome PLC	-	3,020
Ceylon Oxygen Ltd	-	38,566
Konsolidated Multi Trading (Pvt) Ltd	-	13,710
Burser University of Peradeniya	9,500.00	-
Ceylon Printers PLC	9,500.00	-
Precusor Control Authority	11,500.00	-
Sri Lanka Insurance Corporation	2,499.76	-
Gilbert Brothers	22,440.00	-
Mrs. Jeewa Kasthuri	50,000.00	-
	105,439.76	**63,096**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs. 2015	(RESTATED) SLRs 2014
NOTE 3		
STAFF CONSUMPTION LOAN		
M. D. Jeewa Kasthuri	-	186,660
D. G. Gunathilake	82,745.00	120,935
G. Ariyarathne	13,240.00	53,260
A. V. A. P. Kumara	139,970.00	179,990
R. B. Hapukotuwa	143,305.00	183,325
G. W. R. P. Chandrakanthi	169,985.00	79,940
R. M. V. P. Rathnayake	177,780.00	50,015
C. T. K. Thilakarathne	77,790.00	144,450
M. A. P. Perera	124,560.00	139,032
M. P. P. Guruge	23,245.00	63,265
M. A. Lal	183,325.00	129,957
T. C. P. K. Thilakarathne	133,300.00	173,320
G. D. Dharmasena	97,718.00	136,814
D. Aluthpatabendi	166,650.00	86,610
N. P. Athukorale	40,574.00	63,782
A. K. Pathirana	179,990.00	66,600
D. J. M. W. P. Jayasekara	149,975.00	189,995
O.W. K. Senavirathne	116,750.00	150,950
R. B. Weerakoon	-	27,795
R. K. C. Karunarathne	169,985.00	53,260
D. M. K. Lukshmi Kumari	153,310.00	193,330
O.K .S. Opatha	119,960.00	159,980
W.G. Jayasekara Banda	173,320.00	89,945
K. M. Ariyawansa	-	38,150
M. A. G. Somananda	148,360.00	186,280
H. W. M. R. P. M. Weerasooriya	76,605.00	116,625
M. N. B. Kulatunge	29,915.00	69,935
K. G. T. B. Gunasekara	116,625.00	156,645
R. S. K. Gunawardene	200,000.00	40,625
P.S.S. Samarakkody	173,320.00	103,285
C.Illangakoon	79,940.00	119,960
D.S.Jayaweera	59,930.00	99,950
H.M.A.B. Herath	-	33,250
S.S.K. Sakalasooriya	96,615.00	136,635
A.D. Gunawardana	109,955.00	149,975
G.R.A. Basnayake	-	54,480
M.K.D. Keshan	134,222.00	-
R.S.M. Perera	138,895.00	-
I. Tumpale	109,800.00	-
K.I.K. Samarakoon	165,585.00	-
	4,277,244.00	**4,029,005**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

		SLRs 2015	(RESTATED) SLRs 2014
NOTE 4			
DEBTORS & OTHER RECEIVABLES			
Staff Debtors - Festival Advance	(Note 4A)	-	44,000
Advances & Other Receivables	(Note 4B)	98,361.66	217,639
		98,361.66	**261,639**

NOTE 4A

STAFF DEBTORS - FESTIVAL ADVANCES

A.K. Pathirana		1,000
A.V.A.P. Kumara	-	1,000
G.R.N.Rathnayake	-	1,000
C. Illangokoon	-	1,000
D. Alupthpatabendi	-	1,000
D.G. Gunathilaka	-	1,000
D.S. Jayaweera	-	1,000
G.A.R. Basnayake	-	1,000
G.D. Dharmasena	-	1,000
D.J.M.W. P. Jayasekara	-	1,000
M.D.P.K.Malwewa	-	1,000
G.W.R. Chandrakanthi	-	1,000
H.M.A.B. Herath	-	1,000
I. Tumpela	-	1,000
K.G.T.B. Gunasekera	-	1,000
K.I.K. Samarakoon	-	1,000
Lakshmi Kumari	-	1,000
M. A. G. Somananda	-	1,000
M.K. Nissanka	-	1,000
M.A. Lal	-	1,000
M.A.P. Perera	-	1,000
M.D. Jeewa Kasthuri	-	1,000
M.P. Palliyeguruge	-	1,000
M.K.D. Keshan	-	1,000
N.P. Athukorale	-	1,000
O.W.K. Senevirathne	-	1,000
P.S.S. Samarakkody	-	1,000
R.B. Hapukotuwa	-	1,000
R.K.C. Karunaratne	-	1,000
R.S.K. Gunawardena	-	1,000
R.M.V.P. Rathnayaka	-	1,000
R.S.M. Perera	-	1,000
S. Opatha	-	1,000
S.K. Sakalasooriya	-	1,000
T.C.P. Tilakaratne	-	1,000
T.P. Wijewickrama	-	1,000
T.P. Gamalath	-	1,000
B.J.Weerasooriya	-	1,000
W. D. S. P. Perera	-	1,000

	SLRs 2015	(RESTATED) SLRs 2014
C.L.Kehelpannala	-	1,000
W.W.M.A.B. Medawatta	-	1,000
E.M.H.G.S. Ekanayake	-	1,000
C.O. Gunasena	-	1,000
P.S.B. Waduragala	-	-
K.M. Ariyawanse	-	-
	-	44,000

NOTE 4B

ADVANCES & OTHER RECEIVABLES

Teleophone Charges - Aroma Security Service		4,071.00	-
Mrs. Priyadarshika Ruwanpitiya - Rizobium (Invoice No. 31/2015)		7,500.00	-
Mr. A.M.B.N. Abeysinghe - Rizobium (Invoice No. 29/2015)		15,000.00	-
Transport - National Science Foundation		5,112.00	-
Travelling - National Science Foundation	(Invoice No. 16/201:	500.00	-
Over Time - National Science Foundation		596.25	-
Transport - NSF		-	43,713
Accomodation - S. Sayanthooran		-	2,500
Telephone - Security		-	783
BOC - Bank Charges Refund		-	6,000
Stamp Imprest		7,500.00	8,500
N.I.F.S. E.P.F.1%		45,454.45	46,482
Transport - Dr.M.C.M.Iqbal		-	77
Accomadation -F. Hussain		5,000.00	-
Accomadation - G. Ariyarathne		600.00	-
Accomadation - T.C.P.Thilakarathne		-	1,312
Accomadation - Ms.S.S.Weerakkody		-	2,500
Accomadation - Miss.Y.Nijanthini		-	1,250
Accomadation - Miss.S.Logini		-	1,250
Ministry of science & Technology		7,027.96	103,272
		98,361.66	217,639

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 5		
STOCKS		
Chemical Glassware & Labware	1,172,985.14	1,213,266
Stationery Stores	286,481.89	239,129
Sundry Stores	228,779.76	367,070
Publications	151,170.04	151,880
Consignee Stock - Publications	17,405.84	17,406
Building Maintenance	312,191.38	277,678
Goods in Transit	-	17,475
	2,169,014.05	**2,283,904**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

		SLRs 2015	(RESTATED) SLRs 2014
NOTE 6			
PROVIDENT FUND INVESTMENT			
CERTIFICATE NO.			
1	2-0015-03-19546	4,778,587.29	4,450,994
2	2-0015-03-19538	4,765,989.94	4,439,260
3	2-0015-03-19511	4,765,989.94	4,439,260
4	2-0015-03-19520	4,765,989.94	4,439,260
5	200-15-03-20153	2,848,489.80	2,664,630
6	2-0015-03-18809	4,646,835.32	4,328,275
7	2-0015-03-19988	2,982,993.14	2,778,496
8	2-0015-17-56516	2,234,095.55	2,089,893
9	2-0015-03-20005	2,234,095.55	2,089,893
10	2-0015-17-56486	2,234,095.55	2,089,893
11	2-0015-17-56508	4,274,258.53	3,981,239
12	2-0015-03-21192	4,019,716.40	3,760,259
13	2-0015-03-18752	4,017,317.75	3,694,425
14	2-0015-03-21737	2,309,728.12	2,179,400
15	2-0015-03-21745	3,464,592.18	3,269,100
16	2-0015-18-64203	3,000,000.00	-
17	2-0015-18-52078	3,000,000.00	-
18	2-0015-18-28827	2,000,000.00	-
19	2-0015-18-28843	3,000,000.00	-
		65,342,775.00	**50,694,277**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

NOTE 7

FIXED ASSETS

COST

(SL Rs)

DEACRIPTION	TOTAL AS AT 01.01.2015 (RESTATED)	ADDITIONS	ADJUSTMENT/ DISPOSABLE	TOTAL AS AT 31.12.2015 (RESTATED)
Land	28,622,151.00	-	-	28,622,151.00
Buildings	31,124,596.91	448,000.00	-	31,572,596.91
Laboratory Equipment	250,712,306.26	29,110,974.49	-	279,823,280.75
Machinery Tools & Implements	999,924.28	77,957.36	-	1,077,881.64
Motor Vehicles	20,574,263.55	17,958,000.00	(20,570,263.55)	17,962,000.00
Library Books	13,518,745.63	1,247,689.87	-	14,766,435.50
Refrigerators	1,757,255.38	594,835.00	-	2,352,090.38
Air Conditioners	5,250,767.80	286,879.50	-	5,537,647.30
Communication Equipment	882,315.42	21,290.00	-	903,605.42
Computers & Printers	20,424,482.97	4,189,654.18	-	24,614,137.15
Computer Software	408,160.00	-	-	408,160.00
Furniture & fittings	3,928,449.94	570,492.30	-	4,498,942.24
Sport Items	13,480.00	-	-	13,480.00
Office & Miscellaneous Equipment	19,714,982.66	857,632.69	-	20,572,615.35
	397,931,881.80	**55,363,405.39**	**(20,570,263.55)**	**432,725,023.64**

DEPRECIATION

DESCRIPTION	TOTAL AS AT 01.01.2015	CHARGE FOR TH YEAR	ADJUSTMENT/ DISPOSABLE	TOTAL AS AT 31.12.2015
Buildings	21,756,967.08	1,440,138.13	-	23,197,105.21
Laboratory Equipment	69,886,841.14	25,728,290.43	222,282.14	95,837,413.71
Machinery Tools & Implements	351,785.40	93,184.57	59.96	445,029.93
Motor Vehicles	13,238,978.15	3,714,424.34	(13,701,006.31)	3,252,396.18
Library Books	12,463,727.74	609,368.15	-	13,073,095.89
Refrigerators	500,885.94	188,609.86	-	689,495.80
Air Conditioners	1,877,110.00	529,023.85	-	2,406,133.85
Communication Equipment	280,060.28	85,236.65	-	365,296.93
Computers / Printers	14,364,552.56	3,951,361.81	-	18,315,914.37
Computer Software	49,482.41	102,040.00	-	151,522.41
Furniture & fittings	1,057,956.32	416,598.76	-	1,474,555.08
Sport Items	13,480.00	-	-	13,480.00
Office & Miscellaneous Equipment	8,710,653.18	3,757,614.61	-	12,468,267.79
	144,552,480.20	**40,615,891.16**	**(13,478,664.21)**	**171,689,707.15**
Written down value	**253,379,401.60**			**261,035,316.49**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 8		
ACCOUNTS PAYABLE		
Creditors - Suppliers & Services (Note 8A)	4,556,026.86	999,073
Other Creditors and Payable (Note 8B)	900.00	132,869
	4,556,926.86	**1,131,942**
NOTE 8A		
CREDITORS-SUPPLIERS & SERVICES		
S.A.Samaranayake	-	4,000.00
General Upkeep - Janitorial	74,725.20	65,460
General Upkeep - Garden Maintenance	45,854.10	39,000
General Upkeep - Catering	-	25,000
Department of Inland Revenue (stamp)	16,730.00	13,455
Department of Inland Revenue (PAYE tax)	38,201.57	12,516
LHC Associates Pvt Ltd	200,820.00	-
Kandy Tyre Rebuilding Co. Ltd	66,215.00	115,869
Mr.P.G.Chamila Sanka Wickrama	174,850.00	115,530
Mr.T. Gamini Silva	48,300.00	46,200
Security Services	179,883.94	174,082
New Central Hardware	-	30,400
Microref Airconditioning Engineers	2,250.00	-
Hemsons International (Pte) Ltd	1,616,860.55	-
EWIS Peripheral (Pvt) Ltd	-	14,500
Exodus Labtech 9pvt0 LTD	-	4,000
ACE International Express (Pvt) Ltd	-	5,152
A.P Enterprises	91,203.72	-
Microtech Biological Pvt Ltd	94,350.00	-
S. A. D. Associates	25,118.19	-
Dr. P.S.B. Wanduragala	500.00	-
Sri Ramya	93,782.50	-
C. Illangakoon	2,000.00	-
Gatambe Motors	4,800.00	22,500
Indra Motors Spare (Pvt) Ltd	-	39,900
Prof. A. Nanayakkara	84.00	-
D.B. Dissanayake	160.00	-
G.R.N. Rathnayake	1,880.00	-
Mr.L. Wenkdasamy	-	1,140
Saman Priyadeva	1,600.00	-
Solvem Trading Company	-	27,350
Avanhala	106,170.00	-
M.M.Quader	1,000.00	-
The International Hardware Stores	3,620.00	-
Atlas Electricals	1,860.00	-
United Professional Agencies Pvt Ltd	15,000.00	-

	SLRs 2015	(RESTATED) SLRs 2014
Avon Phamo Chem Pvt Ltd	69,113.04	-
P & T Trading Pvt Ltd	403,320.00	-
Narah Stationers	-	17,475
Analytical Instruments (Pvt) Ltd	1,038,353.05	125,077
Refco Engineering Center	-	750
Qualitron (Pvt) Ltd	-	70,280
R.B.Hapukotuwa	-	3,800
R.S.M.Perera	-	5,200
E.M.G.S.Ekanayake	-	2,014
Mohan Perera	500.00	2,000
Danushka Malwewa	200.00	200
B.J.Weerasooriya	475.00	340
S.B.Freight	-	15,883
Sandamali Motors	100,947.00	-
Hansana Construction	35,300.00	-
	4,556,026.86	**999,073**

NOTE 8B

OTHER CREDITORS & PAYABLE

NRC Rent (Refundable Deposit)	-	90,000
Disposable Item (Refundable Deposit)	900.00	900
Malwatte Contractors	-	27,000
Sooner Scientific	-	14,969
	900.00	**132,869**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 9		
ACCRUED EXPENSES		
Tax - Prof. Karunarathne	-	400
Overtime -	-	6,828
Internet	-	286
Telephone	-	756
Salary - Chariman	-	75,889
Traveling & Subsistence	7,853.50	7,375
Government Audit Fees	621,578.00	422,592
Temporary Staff Allowance - NIFS	91,287.50	68,000
Temporary Staff Allowance - Grant	341,942.74	360,913
Communication	64,836.46	45,602
Overtime - NIFS	110,310.88	91,007
Overtime - Grant	1,089.12	6,831
Water Charges	112,584.70	83,395
Internet	233,874.61	467,361
Miscellaneous	-	8,650
Visiting Salary - NIFS	117,305.18	44,199
Electricity	242,362.05	250,388
Paper Bill	-	1,760
Visiting Research Allowance - Grant	89,143.16	10,016
	2,034,167.90	**1,952,248**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 10		
SPECIFIED FUNDS & GRANTS		
I. F. S. Provident Fund	70,836,667.12	59,571,238
Retired Members Fund	1,704,528.75	1,738,712
Festival Advance Fund	300,000.00	256,000
Consumption Loan Fund	225,398.09	289,668
Specified Grants (NOTE-10A)	13,571,508.05	13,038,432
Research Grants Fund	2,210,376.93	2,055,701
	88,848,478.94	**76,949,751**
NOTE 10A		
SPECIFIED GRANT BALANCES		
School Science Programme - Engineering	2,410.00	4,750
School Science Programme	59.463.36	
BES Grant	57,311.72	62,412
RG/2006/AASR/04 - Dr. G. Seneviratne	-	54,506
RG/2006/EB/08	-	35,522
RG/2015/EB/04 - Dr. Benjamin	1,942,000.00	-
Scientia Magazine	174,705.75	174,706
Dayata kirula	13,825.28	13,825
Sample Analysis - Outside Funds	422,600.58	482,491
Bioassaya	43,442.83	43,443
Vidu Kirana	973,134.58	159,307
Annual Review	360,976.00	236,670
Sola- Asia	178,442.95	306,563
Tube Chanel	-	-
Symposium	277,240.07	282,740
University Of Sydney	2,398.11	2,398
RG/2011/BS/01	-	116,118
HETC Project	118,298.48	168,893
Anuradapura District Tank	-	-
RG/2011/AG/09 - Dr. R. Liyanage	-	78,285
IFS Sweeden Grant	1,052,575.68	380,013
Rhizobium Grant	308,995.01	1,247,082
PV Workshop - Prof. L. Dissanayake	9,831.78	9,832
RG/2012/BS/06 - NSF - Prof. N.S. Kumar	-	9,361
NSF/SCH/2012/02 - Postgraduate Research	-	416,773
RG/2012/NRB/03 - Dr. N.D. Subasinghe	24,146.60	255,925
RG/2012/BS/04 - Prof. L.Dissanayake	519,989.98	524,823
Water Quality - Mr. Padmasiri	31,542.51	31,543
Tokyo Cement - Dr. Iqbal	92,400.00	92,400
NSF - RG/2012/AG/01 - Dr. Jayasinghe	144,462.10	18,486
NSF-RG/2012/ESA/01	309,066.26	823,518
Spectra Industries	290,000.00	290,000
MTR Indian Grant	2,686,354.39	2,717,719
NSF-Vidu Nena Dasuna	204,392.39	415,340
President Sri Lanka Society	22,000.00	22,000

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
Sample Analyzed - Dr.Meththika	-	62,000
NSF-RG/2014/EB/03	1,834,406.23	1,540,000
BIO Film	67,934.03	209
N.W.I.B.M.N.S(Enzyme Inhibitory Studies)	177,618.26	13,352
Plant Nursary in Dambulla ARB	22,596.76	355,265
Tissue Culture - Kantale	-	963,126
NSF-RG/2014/BS/02	563,647.91	452,828
South East University - Oluvil	572,188.32	163,098
Young Scientists Symposium	11,110.13	11,110
	13,571,508.05	**13,038,432**

NOTE 11

DIFFERED LIABILITIES

Provision for Retirement Gratuity	19,910,287.50	18,970,558
	19,910,287.50	**18,970,558**

NOTE 12

CAPITAL FUND SPEND AND UNSPENT

Capital Fund Spent

Capital Fund Spent	394,540,173.02	274,135,896
Government Grant Capital Spent(Current Year)	23,211,969.24	100,191,244
	417,752,142.26	**374,327,140**

Capital Fund Unspent

Capital Fund Unspent	1,281,244.35	1,885,522
Government Grant Capital Unspent(Current Year)	112,789,030.76	19,608,756
	114,070,275.11	**21,494,278**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 13		
OTHER INCOME		
Foreign & Local Grants (NOTE 13A)	9,570,596.37	10,771,768
Donation	4,162.86	17,775
Sale of Books	839.60	1,054
Sundry Income	209,354.45	189,982
Interest Received	327,757.99	300,296
Foreign Currency Exchange Gaining	548,209.06	62,261
Income - Hiring Auditorium		76,000
Income - Accomadation	644,896.77	689,783
Sale of Disposable Items		581
	11,305,817.10	**12,109,500**
NOTE 13A		
FOREIGN & LOCAL GRANTS INCOME		
School Science Programme	268,286.97	253,507
School Science Programme - Engineering	70,590.00	-
BES	5,100.50	-
NSF- RG/SCH/2012/02	416,773.01	146,909
RG/2012/NRB/03	558,184.66	788,853
Bioassays	-	6,000
RS/2015/EB/04	35,000.00	-
Water Quality	-	15,014
Vidukirana	-	21,940
Annual Review	50,694.00	63,330
Sola - Asia	128,119.80	4,350
Symposium	5,500.00	5,500
University of Sydney	-	473,344
HETC Project	134,672.34	72,797
Rhizobium - Prof. Kulasooriya	2,376,967.07	1,231,714
PV Workshop - Prof. L.Dissanayake	-	30,200
RG/2011/AG/09	-	13,272
RG/2012/BS/06 NSF - Prof. Kumar	9,361.29	721,171
Tokyo Cement - Dr. Iqbal	-	53,100
NSF- RG/2012/AG/01 - Dr. Jayasinghe	465,000.00	544,607
RG/2011/BS/04	400,000.00	-
NSF/ESA/01	925,451.75	623,396
Traning Programme	-	928,680
MTR Indian Grant	338,309.28	557,080
Specified Research Grant Fund	5,554.00	3,536
RG/2012/BS/04	-	486,800
Sample Analysis -Outside Funds	104,618.93	107,612
Vidu Nena Dasuna	210,947.96	214,440
UNESCO	367,771.00	1,244,259
CEY Water	-	364,471
RG/2014/EB/03	1,435,593.77	122,500
BIO Film	-	148,139

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
N.W.I.B.M.N.S	-	1,294,170
Plant Nursary in Dambulla ARB	332,668.24	38,735
Tissue Culture - Kantale	127,413.59	36,874
RG/2014/BS/02	727,108.09	70,000
C.I.R. Equipment	-	39,676
South East University - Oluvil	70,910.12	6,902
Young Scientists Symposium	-	38,890
	9,570,596.37	**10,771,768**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

NOTE 14

EXPENDITURE FOR PERSONAL EMOLUMENTS

		SLRs 2015	(RESTATED) SLRs 2014
Salaries	(Appendix 01)	96,177,552.54	73,651,407
EPF	(Appendix 01)	12,557,192.42	9,763,718
ETF	(Appendix 01)	2,511,438.48	1,952,744
Temporary Staff Allowances		951,887.50	962,075
Overtime		1,263,963.56	1,179,194
		113,462,034.50	**87,509,138**

NOTE 15

TRAVELLING

Local	(Appendix 01)	298,384.50	245,331
Foreign	(Appendix 01)	864,788.20	782,350
		1,163,172.70	**1,027,681**

NOTE 16

EXPENDITURE FOR SUPPLIERS & CONSUMABLES

Stationery & Office Requisites	(Appendix 01)	510,138.23	471,717
Fuel and Lubricants		1,947,909.51	2,398,096
Chemical & Glassware	(Appendix 01)	5,964,449.78	6,450,133
Consumable	(Appendix 01)	7,782,770.39	7,184,942
		16,205,267.91	**16,504,888**

NOTE 17

EXPENDITURE FOR MAINTENANCE

Building	(Appendix 01)	936,259.59	1,389,744
Equipment	(Appendix 01)	4,241,225.30	3,615,362
Vehicle		2,028,822.61	2,631,913
		7,206,307.50	**7,637,019**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 18		
EXPENDITURE FOR CONTRACTUAL SERVICES		
Transport	559,228.71	545,372
Telecommunication	673,623.76	753,549
Postage	139,326.00	118,255
Electricity	6,836,870.77	7,280,248
Water	2,194,349.25	1,638,252
Garden Maintenance	550,249.20	468,000
Janitorial Services	896,702.40	785,520
Security Services	2,158,607.28	2,078,484
Catering Services	300,000.00	300,000
Internet Service	2,899,209.73	2,273,330
	17,208,167.10	**16,241,010**
NOTE 19		
OTHER EXPENDITURE		
Advertisement	430,513.50	300,748
Arboretum Expenses	180,000.00	180,000
Audit Fees	200,000.00	250,000
Auditorium And Room Maintenance	215,497.98	73,152
Bank Charges	32,490.00	50,080
Entertainment	6,000.00	5,845
Grant Expenses (Note 19A)	9,570,596.37	10,771,768
Gratuity	1,839,790.00	3,721,449
Staff Insurance	600,387.01	438,419
Insurance - Building	386,707.08	383,160
Insurance Motor Vehicle & License Fee	858,341.04	509,904
Journal Periodicals & Subscription	507,245.98	483,419
Membership Fees	734,276.66	518,296
Miscellaneous	575,721.40	775,972
Printing / Photocopy	529,229.00	52,428
Publication - Donation	-	291
Research Council Meeting Expenses	48,290.00	38,354
Welfare	1,909,744.31	1,571,950
Legal Expenses	52,500.00	-
Annual Review - IFS	367,395.00	232,402
Room Expenditure	-	573,580
IFS Science Week	-	18,432
Local Registration Fees	81,000.00	-
	19,125,725.33	**20,949,649**

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31.12.2015

	SLRs 2015	(RESTATED) SLRs 2014
NOTE 19A		
GRANT EXPENSES		
School Science Programme	268,286.97	253,507
School Science Programme - Engineering	70,590.00	-
BES	5,100.50	-
NSF- RG/SCH/2012/02	416,773.01	146,909
RG/2012/NRB/03	558,184.66	788,853
Water Quality	-	15,014
Vidu Kirana	-	21,940
Annual Review	50,694.00	63,330
Sola - Asia	128,119.80	4,350
Symposium	5,500.00	5,500
University of Sydney	-	473,344
HETC Project	134,672.34	72,797
Rhizobium - Prof. Kulasooriya	2,376,967.07	1,231,714
PV Workshop - Prof. L.Dissanayake	-	30,200
RG/2011/AG/09	-	13,272
RG/2012/BS/06 NSF - Prof. Kumar	9,361.29	721,171
Tokyo Cement - Dr. Iqbal	-	53,100
NSF- RG/2012/AG/01 - Dr. Jayasinghe	465,000.00	544,607
RG/2011/BS/04	400,000.00	-
NSF/ESA/01	925,451.75	623,396
Traning Programme	-	928,680
MTR Indian Grant	338,309.28	557,080
Specified Research Grant Fund	5,554.00	3,536
Bioassays	-	6,000
RG/2012/BS/04	35,000.00	486,800
Sample Analysis - Prof.Gamini	104,618.93	107,612
Vidu Nana Dasuna	210,947.96	214,440
UNESCO	367,771.00	1,244,259
CEY Water	-	364,471
RG/2014/EB/03	1,435,593.77	122,500
BIO Film	-	148,139
N.W.I.B.M.N.S	-	1,294,170
Plant Nursary in Dambulla ARB	332,668.24	38,735
Tissue Cultrue - Kantale	127,413.59	36,874
NSF - RG/2014/BS/02	727,108.09	70,000
C.I.R.Equipment	-	39,676
South East University - Oluvil	70,910.12	6,902
Young Scientists Symposium	-	38,890
	9,570,596.37	**10,771,768**

)IX 01

:T RECURRANT EXPENDITURE

PROJECT	CHEMICAL & GLASSWARE, CONSUMABLE	EQUIPMENT MAINTANANCE	BUILDING MAINTANANCE	FOREIGN TRAVELLING	STATIONARY	TRANSPORT	LOCAL TRAVELLING	COMMUNICATION	ADVERTISING	SALARIES, EPF,ETF
)TECHNOLOGY	312,318	90,120	83,039	88,000	23,998	7,730	46,389	-	-	5,805,307
CAL & COMPUTATIONAL	460,993	21,277	2,148	-	2,314	-	-	-	-	3,477,117
PRODUCT CHEMISTRY	1 117,366	136,574	42,914	81,682	13,887	10,110	8,213	4,373	-	9,007,505
OGY	1,157,421	42,446	6,726	78,213	11,743	2,100	5,550	3,000	-	4,057,467
'ATE CHEMISTRY	402,417	39,265	1,460	87,600	8,118	-	5,400	-	-	3,006,978
E MATTER PHYSICS										2,154,080
EMISTRY	846,387	775,917	8,380	26,674	20,508	6,735	1,550	8,047	-	6,681,034
& ENVIRONMENTAL	1,116,599	85,811	42,519	38,850	8,632	300	28,574	750	-	4,532,516
L BIOTECHNOLOGY										
MED BIO FERTILIZER	1,311,843	13,462	38,436	-	9,423	4,100	28,125	-	-	9,791,522
LL	2,058,275	19,526	13,451	111,465	9,165		31,175	-	-	
MAL RESOURCE	117,546	26,335	6,975	68,805	9,537	-	25,031	-	-	5,488,708
& ENVIORONMENTAL G	1,126,847	34,354	102,608	88,000	11,820	400	10,875	26,010	-	4,195,744
CHEMICAL MATERIALS	818,374	17,812	5,800	88,000	12,531	-	2,650	4,052	-	4,465,348
ENCE NATURAL - I	1,357,203	17,548	5,896	19,500	2,224	400	1,350	-	-	4,311,910
ENCE NATURAL - II	1,432,314	57,828	2,146	88,000	3,858	-	3,750	-	-	3,239,926
RATION	111,318	2,862,951	573,764	-	362,381	527,354	99,754	627,392	430,514	41,031,021
	13,747,220	**4,241,225**	**936,260**	**864,788**	**510,138**	**559,229**	**298,385**	**673,624**	**430,514**	**111,246,183**

AGE ANALYSIS OF DEBTORS & OTHER RECEIVABLES AS AT 31.12.2015

ADVANCES AND OTHER RECEIVABLES Rs.98,361.66 :

	0 - 12 MONTHS Rs	1 - 2 YEARS Rs	2 - 3 YEARS Rs	3-4 YEARS Rs	4 - 5 YEARS Rs	OVER 5 YEARS Rs
Teleophone Charges - Aroma Security Service	4,071.00	-	-	-	-	-
Mrs. Priyadarshika Ruwanpitiya - Rizobium (Invoice No. 31/2015)	7,500.00	-	-	-	-	-
Mr. A.M.B.N. Abeysinghe - Rizobium (Invoice No. 29/2015)	15,000.00	-	-	-	-	-
Transport - National Science Foundation	5,112.00	-	-	-	-	-
Travelling - National Science Foundation	500.00	-	-	-	-	-
Over Time - National Science Foundation	596.25	-	-	-	-	-
Stamp Imprest	7,500.00	-	-	-	-	-
N.I.F.S. E.P.F.1%	45,454.45	-	-	-	-	-
Accomadation -F. Hussain	5,000.00	-	-	-	-	-
Accomadation - G. Ariyarathne	600.00	-	-	-	-	-
Ministry of science & Technology	-	7,027.96	-	-	-	-
	91,333.70	**7,027.96**	**-**	**-**	**-**	**-**

AGE ANALYSIS OF ACCRUED EXPENSES & ACCOUNTS PAYABLE AS AT 31.12.2015

ACCRUED EXPENSES Rs.2,034,167.90:

	0 - 12 MONTHS Rs	1 - 2 YEARS Rs	2 - 3 YEARS Rs	3-4 YEARS Rs	4 - 5 YEARS Rs	OVER 5 YEARS Rs
Traveling & Subsistence	7,853.50	-	-	-	-	-
Government Audit Fees	198,986.00	422,592.00	-	-	-	-
Temporary Staff Allowance - NIFS	91,287.50	-	-	-	-	-
Temporary Staff Allowance - Grant	341,942.74	-	-	-	-	-
Communication	64,836.46	-	-	-	-	-
Overtime - NIFS	110,310.88	-	-	-	-	-
Overtime - Grant	1,089.12	-	-	-	-	-
Water Charges	112,584.70	-	-	-	-	-
Internet	233,874.61	-	-	-	-	-
Visiting Salary - NIFS	117,305.18	-	-	-	-	-
Electricity	242,362.05	-	-	-	-	-
Visiting Research Allowance - Grant	89,143.16	-	-	-	-	-
	1,611,575.90	**422,592.00**	-	-	-	-

OTHER CREDITORS AND PAYABLE BALANCE Rs.900.00 :

	0 - 12 MONTHS Rs	1 - 2 YEARS Rs	2 - 3 YEARS Rs	3-4 YEARS Rs	4 - 5 YEARS Rs	OVER 5 YEARS Rs
	-	-	-	-	-	-
Disposable Item (Refundable Deposit)	-	-	900.00	-	-	-
	-	-	**900.00**	-	-	-

CREDITORS-SUPPLIERS AND SERVICES Rs.4,556,026.86 :

	0 - 12 MONTHS Rs	1 - 2 YEARS Rs	2 - 3 YEARS Rs	3-4 YEARS Rs	4 - 5 YEARS Rs	OVER 5 YEARS Rs
General Upkeep - Janitorial	74,725.20	-	-	-	-	-
General Upkeep - Garden Maintenance	45,854.10	-	-	-	-	-
Department of Inland Revenue (stamp)	16,730.00	-	-	-	-	-
Department of Inland Revenue (PAYE tax)	38,201.57	-	-	-	-	-
LHC Associates Pvt Ltd	200,820.00	-	-	-	-	-
Kandy Tyre Rebuilding Co. Ltd	66,215.00	-	-	-	-	-
Mr.P.G.Chamila Sanka Wickrama	174,850.00	-	-	-	-	-
Mr.T. Gamini Silva	48,300.00	-	-	-	-	-
Security Services	179,883.94	-	-	-	-	-
Microref Airconditioning Engineers	2,250.00	-	-	-	-	-
Hemsons International (Pte) Ltd	1,616,860.55	-	-	-	-	-
A.P Enterprises	91,203.72	-	-	-	-	-
Microtech Biological Pvt Ltd	94,350.00	-	-	-	-	-
S. A. D. Associates	25,118.19	-	-	-	-	-
Dr. P.S.B. Wanduragala	500.00	-	-	-	-	-
Sri Ramya	93,782.50	-	-	-	-	-
C. Illangakoon	2,000.00	-	-	-	-	-
Gatambe Motors	4,800.00	-	-	-	-	-
Prof. A. Nanayakkara	84.00	-	-	-	-	-
D.B. Dissanayake	160.00	-	-	-	-	-
G.R.N. Rathnayake	1,880.00	-	-	-	-	-
Saman Priyadeva	1,600.00	-	-	-	-	-
Avanhala	106,170.00	-	-	-	-	-
M.M.Quader	1,000.00	-	-	-	-	-
The International Hardware Stores	3,620.00	-	-	-	-	-
Atlas Electricals	1,860.00	-	-	-	-	-
United Professional Agencies Pvt Ltd	15,000.00	-	-	-	-	-
Avon Phamo Chem Pvt Ltd	69,113.04	-	-	-	-	-
P & T Trading Pvt Ltd	403,320.00	-	-	-	-	-
Analytical Instruments (Pvt) Ltd	1,038,353.05	-	-	-	-	-
Mohan Perera	500.00	-	-	-	-	-
Danushka Malwewa	200.00	-	-	-	-	-
B.J.Weerasooriya	475.00	-	-	-	-	-
Sandamali Motors	100,947.00	-	-	-	-	-
Hansana Construction	35,300.00	-	-	-	-	-
	4,556,026.86	-	-	-	-	-

TRIAL BALANCE AS AT31.12.2015

NO		DEBIT	CREDIT
F/A/1	AIR CONDITIONER	5,537,647.30	-
F/A/2	BUILDING	31,572,596.91	-
F/A/3	COMPUTER & PRINTERS	24,614,137.15	-
F/A/4	COMMUNICATION EQUIPMENT	903,605.42	-
F/A/5	FURNITURE & FITTINGS	4,498,942.24	-
F/A/6	IMPROVEMENTS TO BUILDING	-	-
F/A/7	LAND	28,622,151.00	-
F/A/8	LABORATORY EQUIPMENT	279,823,280.75	-
F/A/9	LIBRARY BOOKS	14,766,435.50	-
F/A/10	MOTOR VEHICLE	17,962,000.00	-
F/A/11	MACHINERY TOOLS & IMPLEMENTS	1,077,881.64	-
F/A/12	OFFICE & MISCELLANEOUS EQUIPMENT	20,572,615.35	-
F/A/13	REFRIGERATORS	2,352,090.38	-
F/A/14	SPORT ITEMS	13,480.00	-
F/A/15	MOTOR VEHICLE OVERHALL	-	-
F/A/16	KITCHEN EQUIPMENT	-	-
F/A/17	TRAINING CAPACITY	882,197.40	-
F/A/18	COMPUTER SOFTWARE	408,160.00	-
O/F/A/1	EMPLOYEE PROVIDENT FUND INVESTMENT	65,342,775.00	-
O/F/A/2	DISPOSABALE OF FIXED ASSETS	24,915,351.37	-
O/F/A/3	MODEL OF LAND	37,500.00	-
O/F/A/4	INVESTMENT OF CONSUMPTION LOAN	225,398.09	-
O/F/A/5	GEOTERMAL MAPPING REPORT	1,097,477.65	-
O/F/A/6	NEW BUILDING - WORKING PROGRES	142,920,000.00	-
C/A/1	BUILDING MAINTENANCE STOCK	312,191.38	-
C/A/2	CHEMICAL GLASSWARE AND LAB WARE STOCK	1,172,985.14	-
C/A/3	CONSIGNED STOCK	17,405.84	-
C/A/4	STATIONERY STOCK	286,481.89	-
C/A/5	SUNDRY STOCK	228,779.76	-
C/A/6	PUBLICATION STOCK	151,170.04	-
C/A/10	INSURANCE CLAIM RECEIVABLE(JANASHAKTHI)	-	-
C/A/11	ADVANCE TO SUPPLIES & OTHERS	105,439.76	-
C/A/12	FOREIGN PAYMENTS ON ADVANCE	11,016,644.68	-
C/A/13	LETTER OF CREDIT MARGIN	6,623,888.42	-
C/A/14	FESTIVAL ADVANCE	-	-
C/A/15	SPECIAL ADVANCE	-	-
C/A/16	SALARY ADVANCE	-	-
C/A/17	SCIENCE WEEK PROJECT	-	-
C/A/18	REFUNDABLE DEPOSIT	441,100.00	-
C/A/19	PREPAYMENT	1,505,778.85	-
C/A/20	OTHER RECEIVABLE ACCOUNT	90,861.66	-
C/A/21	INTEREST RECEIVABLE FOR FIXED DEPOSIT	3,195,205.54	-
C/A/22	NRC BUILDING DEPOSIT	-	-
C/A/23	REFUNDABLE DEPOSIT FOR DISPOSABLE ITEMS	-	900.00
C/A/24	REFUNDABLE BENCH FEES	-	-
C/A/26	SOONER SCIENTIFIC	-	-
C/A/27	PRELIMINARY EXPENSES FOR CONTRUCTION	20,000.00	-
C/A/36	HYDRAULIC JACK	4,000.00	-
C/A/38	BOOK RACK NATU . PRODUCT	-	-
C/A/39	STAND ST, GEOLOGY	4,960.00	-
C/A/40	FESTIVAL ADVANCE INVESTMENT ACCOUNT	300,000.00	-
C/A/41	DIRECTOR BUILDING DEPARTMENT - ADVANCE	614,980.37	-
C/A/42	YOUNG SCIENTISTS SYMPOSIUM	-	11,110.13
C/A/43	NEW RACK STORES	5,952.50	-

C/A/45	NEW SCIENCE BUILDING	-	-
C/A/46	GOODS IN TRANSIT	-	-
L/1	ACCRUED EXPENSES	-	2,034,167.90
L/2	CREDITORS	-	4,520,726.86
L/3	CAPITAL FUND SPENT	-	394,540,173.02
L/4	CAPITAL FUND UNSPENT	-	1,281,244.35
L/5	E.P.F. PAYABLE	-	-
L/6	E.T.F. PAYABLE	-	-
L/8	I.F.S.PROVIDENT FUND	-	70,836,667.12
L/10	INSTITUTE FUND	57,235,863.48	-
L/12	PROVISION FOR GRATUITY	-	19,910,287.50
L/13	PROVISION FOR DEPRECIATION	-	171,689,707.15
L/14	PRESIDENT FUND CAPITAL SPENT-SUPPLEMENTARY	-	7,078,501.15
L15	RENT PAYBLE	-	-
L/19	OTHER PAYABLE ACCOUNTS	-	-
L/20	RETENTION MONEY PAYABLE - HANSANA CONSTRUCTION	-	35,300.00
L/21	RETIRED MEMBERS FUND ACCOUNT	-	1,704,528.75
L/22	CAPITAL EXPENDITURE SPECIFIED FUNDS & DONATION	-	2,851,809.73
L/23	SCHOOL SCIENCE PROGRAMME	-	59,463.36
L/24	SCHOOL SCIENCE PROGRAMME - ENGINEERING	-	2,410.00
L/25	BUILDING CONTRACTORS	-	-
L/26	FESTIVAL ADVANCE - FUND ACCOUNT	-	300,000.00
L/28	CONSUMPTION FUND	-	225,398.09
L/36	SPECIFIED RESEARCH GRAND FUND	-	2,210,376.93
L/42	BES GRANT	-	57,311.72
L/44	GOV. TAX	-	-
L/45	DEP OF INLAND REVENUE	-	-
L/46	RG/2006/AASR/04 DR GAMINI	-	-
L/48	RG/2006/EB/08	-	-
L/55	BIOASSAYS	-	43,442.83
L/56	SCIENCE MAGAZINE	-	174,705.75
L/65	VIDU KIRANA	-	973,134.58
L/66	ANNUAL REVIEW	-	360,976.00
L/70	SOLA ASIA	-	178,442.95
L/72	SYMPOSIUM	-	277,240.07
L/73	UNIVERSITY OF SYDNEY	-	2,398.11
L/76	RG/2011BS/01 DR NADEESHANI	-	-
L/78	HETC PROJECT	-	118,298.48
L/79	ANURADAPURA DISTRIC TANK	-	-
L/81	RG/2011/AG/09	-	-
L/82	IFS SWEEDEN	-	1,052,575.68
L/83	RHIZOBIUM	-	308,995.01
L/84	RG/2012/AG/01	-	144,462.10
L/86	PV WORK SHOP	-	9,831.78
L/89	RG/2012/BS/06	-	-
L/91	NSF/SCH/2012/02	-	-
L/92	RG/2012/NRB/03	-	24,146.60
L/93	RG/2012/BS/04	-	519,989.98
L/94	WATER QUALITY	-	31,542.51
L/95	TOKYO CEMENT COMPANY	-	92,400.00
L/96	REVALUVATION RESERVE	-	131,630,743.37
L/97	MTR DAYATA KIRULA	-	13,825.28
L/99	SAMPLE ANALIZED - OUTSIDE FUNDS	-	422,600.58
L/100	NSF/ESA/01	-	309,066.26
L/101	RG/2012/EQ/07	-	-
L/102	SPECTRA INDUSTRIES	-	290,000.00
I/104	MTR (INDIAN)	-	2,686,354.39
L/103	TRANNING PROGRAM	-	-

L/106	TOKYO CEMENT - COTTAGE	-	-
L/107	NSF - VIDU NANA DASUNA(VND)	-	204,392.39
L/110	PRESIDENT SRI LANKA SOCITY	-	22,000.00
L/111	SAMPLE ANALIZED PROF: BANDARA	-	-
L/112	SAMPLE ANALIZED DR: METHIKA	-	-
L/113	UNESCO	-	-
L/115	RG/2014/EB/03	-	1,834,406.23
L/116	BIO FILM	-	67,934.03
L/117	N.W.I.B.M.N.S	-	177,618.26
L/118	PLANT NURSERY IN DAMBULLA ARB.	-	22,596.76
L/119	TISSUE CULTURE KANTHALE	-	-
L/120	NSF RG/2014/BS/02	-	563,647.91
L/122	SOUTH EASTERN UNIVERSITY	-	572,188.32
L/125	UNESCO	-	-
L/124	RG/2015/EB/04 DR.BENJAMIN	-	1,942,000.00
L/123	WORLD SCIENCE WEEK	-	-
I/1	FOREIGN CURRENCY EXCHANGE GAINING	-	548,209.06
I/2	GOVERNMENT GRANT RECURRENT	-	154,000,000.00
I/3	GOVERNMENT GRANT CAPITAL -SPENT -RS. 23,211,969.24	-	136,001,000.00
	-UN SPENT RS. 112,789,030.76	-	-
I/4	ACCOMADATION INCOME	-	644,896.77
I/5	HIRING AUDITORIUM	-	-
I/6	INTEREST RECEIVED	-	327,757.99
I/7	SALE OF BOOKS	-	839.60
I/8	SUNDRY INCOME	-	209,354.45
I/9	OVER/UNDER PROVISION	-	-
I/10	DONATION	-	4,162.86
I/13	DISPOSAL OF FIXED ASSETS	81,381.29	-
I/16	FOREIGN & LOCAL GRAND FUND INCOME	-	9,570,596.37
E/1	ADVERTISEMENT	430,513.50	-
E/2	AUDIT FEES	200,000.00	-
E/3	AUDITORIUM AND ROOMS MAINTENANCE EXPENSES	215,497.98	-
E/4	BUILDING INSURANCE	386,707.08	-
E/5	BANK CHARGES	32,490.00	-
E/6	COMMUNICATION	673,623.76	-
E/7	CLEARANCE	50,221.34	-
E/8	DEFENSE LEVY AND GST	274,002.00	-
E/9	DAMBULLA ARBORETUM	180,000.00	-
E/10	ELECTRICITY	6,836,870.77	-
E/11	FUEL	1,947,909.51	-
E/12	GENERAL UP KEEP-JANITORIAL SERVICE	896,702.40	-
E/13	GENERAL UPKEEP-GARDEN MAINTENANCE	550,249.20	-
E/14	GENERAL UPKEEP-CATERING SERVICE	300,000.00	-
E/15	GRATUITY	1,839,790.00	-
E/16	MAINTENANCE OF MOTOR VEHICLES	2,028,822.61	-
E/17	MOTOR VEHICLE INSURANCE	763,916.04	-
E/18	MOTOR VEHICLE LICENSE	94,425.00	-
E/19	MAINTENANCE OF BUILDING	936,259.59	-
E/20	MAINTENANCE OF EQUIPMENT	4,241,225.30	-
E/21	OVERTIME	1,263,963.56	-
E/22	POSTAGE	139,326.00	-
E/23	PRIOR YEAR ADJUSTMENT	9,456,478.64	-
E/24	RESEARCH COUNCIL MEETING EXPENSES	48,290.00	-
E/25	SECURITY	2,158,607.28	-
E/26	STAFF TRANSPORT	559,228.71	-
E/27	ANNUAL REVIEW IFS	367,395.00	-
E/28	SUBSCRIPTION PERIODICALS & JOURNALS	507,245.98	-
E/29	MEMBERSHIP FEES	734,276.66	-

E/30	STAFF INSURANCE	600,387.01	-
E/31	TRAVELLING & SUBSISTENCE	298,384.50	-
E/32	WELFARE	1,909,744.31	-
E/33	WATER	2,194,349.25	-
E/34	SALARY	96,177,552.54	-
E/35	E.P.F. 15%	12,557,192.42	-
E/36	E.T.F. 3%	2,511,438.48	-
E/37	STATIONARY USED	510,138.23	-
E/38	CHEMICAL GLASSWARE AND LABWARE USED	5,964,449.78	-
E/39	CONSUMABLE	7,782,770.39	-
E/40	PRINTING	529,229.00	-
E/41	LEGAL EXPENSES	52,500.00	-
E/43	ENTERTAINMENT ALLOWANCE	6,000.00	-
E/45	DEPRECIATION	40,615,891.16	-
E/47	TEMPORARY STAFF ALLOWANCE	951,887.50	-
E/49	MISCELLANEOUS	575,721.40	-
E/50	INTERNET	2,899,209.73	-
E/53	FOREIGN &LOCAL GRAND EXPENDITURE	9,570,596.37	-
E/54	PUBLICATION DONATION	-	-
E/56	TRAVELLING FOREIGN	864,788.20	-
E/57	ROOM EXPENDITURE	-	-
E/58	DESPOSAL YEAR 2013	-	-
E/59	IFS SCIENCE WEEK	-	-
E/60	LOCAL REGISTRATION FEES	81,000.00	-
O/C/B/1	NATIONAL SAVINGS BANK. A/C NO1-0015-01-02989	2,027,627.70	-
O/C/B/2	RESEARCH FUND N.S.B.1-0015-01-03152	67,096.54	-
O/C/B/3	PETTY CASH CONTROL ACCOUNT	-	-
O/C/B/4	STAMP IMPREST - DIRECTORS' OFFICE	7,000.00	-
O/C/B/5	STAMP IMPREST - ACCOUNTS	500.00	-
O/C/B/6	PROVIDENT FUND CURRENT ACCOUNT B.O.C.32794	1,966,196.94	-
O/C/B/8	COLOMBO OFFICE	-	-
	N.S.B A/C NO.100151091808	225,398.09	-
O/C/B/11	STAFF CONSUMPTION LOAN RECEIVABLE A/C	4,277,244.00	-
	BANK OF CEYLON 32779	114,105,713.24	-
	BANK OF CEYLON 32795	19,025,056.95	-
	CASH	-	-
	SFCA/KN/USD/01	7,698,961.68	-
		1,125,728,857.07	**1,125,728,857.07**
		0.00	

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கணக்காய்வாளர் தலைமை அதிபதி திணைக்களம்
AUDITOR GENERAL'S DEPARTMENT

මගේ අංකය எனது இல. My No. CLP-2/KD/J/NIFS/01 /2015/17

ඔබේ අංකය உமது இல. Your No.

දිනය திகதி Date 03 October 2016

The Director

National Institute of Fundamental Studies

Report of the Auditor General on the Financial Statements of the National Institute of Fundamental Studies for the year ended 31 December 2015 in terms of Section 14(2) (c) of the Finance Act, No. 38 of 1971

The audit of financial statements of the National Institute of Fundamental Studies for the year ended 31 December 2015 comprising the statement of financial position as at 31 December 2015 and the statement of financial performance, statement of changes in equity and cash flow statement for the year then ended and a summary of significant accounting policies and other explanatory information 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 Section 13(1) of the Finance Act, No. 38 of 1971 and Section 36(4) of the National Institute of Fundamental Studies Act, No. 55 of 1981. My comments and observations which I consider should be published with the Annual Report of the Institute in terms of Section 14(2) (c) of the Finance Act appear in this report. A detailed report in terms of Section 13(7) (a) of the Finance Act was issued to the Director of the Institute on 03 May 2016.

1.2 Management's Responsibility 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.

1.3 Auditor's Responsibility

My responsibility is to express an opinion on these financial statements based on my audit. I conducted my audit in accordance with Sri Lanka Auditing Standards consistent with International Auditing Standards of Supreme Audit Institutions (ISSAI 1000 – 1810). Those Standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatements.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Institute's preparation and fair presentation of the financial statements 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 Institute's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of financial statements. Sub-sections (3) and (4) of Section 13 of the Finance Act, No. 38 of 1971 give discretionary powers to the Auditor General to determine the scope and extent of the audit.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

1.4 Basis for Qualified Opinion

My opinion is qualified based on the matters described in paragraph 2.2 of this report.

2. Financial Statements

2.1 Qualified Opinion

In my opinion, except for the effects of the matters described in paragraph 2.2 of this report, the financial statements give a true and fair view of the financial position of the National Institute of Fundamental Studies as at 31 December 2015 and its financial performance and cash flows for the year then ended in accordance with Sri Lanka Public Sector Accounting Standards.

2.2 Comments on Financial Statements

2.2.1 Sri Lanka Public Sector Accounting Standards

The following non-compliances were observed.

(a) **Sri Lanka Public Sector Accounting Standard – 02**

Even though only changes in cash should be indicated in the cash flow statement, transactions amounting to Rs.26,775,848 in which a cash movement had not occurred, had been included in the cash flow statement.

(b) **Sri Lanka Public Sector Accounting Standard – 03**

(i) Even though an entity should correct material prior period errors retrospectively in the first set of financial statements itself issued after their discovery, deviations from Sri Lanka Public Sector Accounting Standards totalling Rs.337,026,080 and accounting deficiencies totalling Rs.129,750 shown in the report of the Auditor General relating to the year 2014 had not been rectified and shown in the financial statements for the year under review.

(ii) The assets costing Rs.65,948,057 had been fully depreciated as the useful life of non-current assets had not been reviewed annually. However, they had still been in use. Accordingly, action had not been taken to revise the estimated error.

(c) **Sri Lanka Public Sector Accounting Standard – 07**

If a class of property, plant and equipment is stated at revalued amounts, the particulars which should be disclosed in respect of those assets such as the effective date of the revaluation, whether an independent valuer was involved and the methods and significant assumptions applied in estimating the assets' fair value, had not been disclosed in the financial statements.

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2.2.1 Sri Lanka Public Sector Accounting Standards

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2.2.2 Accounting Deficiencies

The following observations are made.

(a) The motor vehicles valued at Rs.12,780,000 transferred to the Institute by the Department of National Budget had not been brought to account.

(b) The value of 04 patents obtained in favour of the Institute had not been assessed and disclosed in the financial statements.

(c) House rentals amounting to Rs.160,570 payable to the Sri Lanka Mahaweli Authority had not been brought to account.

2.2.3 Unexplained Differences

Even though the value of 02 fixed deposit certificates as at the end of the year under review had been shown in the financial statements as Rs.5,774,320, according to bank confirmations, it was Rs.5,448,500. The reasons for this difference had not been revealed.

2.2.4 Lack of Evidence for Audit

Evidence indicated against 04 items of account totalling Rs.112,222,982 of the year under review was not made available to audit.

	Item	Value	Evidence not made available to Audit
		Rs.	
(a)	Balance of the Institutional Provident Fund	70,836,667	Audited Final Accounts.
(b)	Balance of the Retired Officers' Fund	1,704,529	-Do-
(c)	Library Books	14,766,435	Boards of Survey Reports
(d)	Laboratory Equipment, Tools and Furniture	24,915,351	-Do-
	Total	112,222,982	

2.3 Accounts Receivable

Action had not been taken to recover a sum of Rs.614,980 recoverable to the Institute out of the advances paid to the Department of Buildings in respect of 5 constructions carried out in the year 2012.

2.4 Non-compliance with Laws, Rules Regulations and Management Decisions

The following non-compliances were observed.

	Reference to Laws, Rules, Regulations etc.	Non-compliance
(a)	Establishments Code of the Democratic Socialist Republic of Sri Lanka Sections 13.1.2 of Chapter II	Even though an officer with a Degree should be appointed for the post of Administrative Officer in terms of the approved Scheme of Recruitment of the Institute, a female Staff Assistant (Clerk) who had not fulfilled the said qualifications had been appointed to the vacant Post of Administrative Officer of the National Institute of Fundamental Studies on acting basis since 24 February 2014.
(b)	Treasury Circulars	
	(i) Treasury Circular No. 842 of 19 December 1978	A Register of Fixed Assets had not been maintained for fixed assets valued at Rs.363,580,492.
	(ii) Treasury Circular No. IAI/2002/02 of 28 November 2002	A Register of Fixed Assets had not been maintained in respect of computers and printers valued at Rs.25,022,297.

(c)	Public Administration Circulars --- Section 7 of Circular No. 25/2014 of 12 November 2014 of the Secretary to the Ministry of Public Administration and Home Affairs.	Fifteen officers had been recruited as trained officers without the approval of the Department of Management Services and assigned them with permanent duties and a total sum of Rs.824,413 had been paid as salaries from the Institute's Funds in the year under review.
(d)	Employees' Provident Fund Act, No. 15 of 1958 and Letter No. ප්‍ර/ආයතන/11 dated 24 August 2001 of the Commissioner of Labour.	As study allowance should not be applicable for the Employees' Provident Fund, Pension Fund and Employees' Trust Fund, contrary to it, an overpayment of Rs.2,364,769 had been made as contributions of the Institute to the above funds as the academic allowance paid to the academic staff had been based.

2.5 Transactions not supported by Adequate Authority

Two posts such as Assistant Librarian and Deputy Accountant had been created without the approval of the Department of Management Services and two officers of the Institute had been promoted to those posts and paid a total sum of Rs.8,448,372 as salaries and Employees' Provident Funds.

3. Financial Review

3.1 Financial Results

According to the financial statements presented, the financial result for the year under review had been a deficit of Rs.49,680,749 as compared with the corresponding deficit of Rs.30,590,273 for the preceding year thus, indicating a deterioration of Rs.19,090,476 in the financial result for the year under review as compared with the preceding year. Even though the Government grants had increased by Rs.9,559,000 as compared with the preceding year, increase in expenditure on personal emoluments and wages by Rs.25,952,896 and the increase in depreciation for non-current assets by Rs.3,344,503 had mainly attributed to this deterioration.

In the analysis of financial results for the year under review and 04 preceding years, there had been a deficit from the year 2011 up to the year 2015 and in considering the employees' remuneration and the depreciations for non-current assets, the contribution of the Institute which had taken a negative value of Rs.64,610,581 in the year 2011, had improved continuously up to a positive value of Rs.104,397,177 in the year 2015.

3.2 Analytical Financial Review

The ability of settling current liabilities using the current assets of the Institute had decreased by 4 per cent due to the decrease of the current ratio from 34 per cent to 30 per cent in the year under review as compared with the preceding year.

4. Operating Review

4.1 Performance

Even though the main objective of the Institute in terms of Section 2(4) of the National Institute of Fundamental Studies Act, No. 55 of 1981 amended by the Act No.05 of 1997 is to pay attention to national requirements and take action so as to improve its protection, it was observed that the research projects implemented by the Institute had not been prepared so as to fulfil the national requirements. Only 11 patents had been obtained from the National Intellectual Property Office of Sri Lanka and countries such as Korea and Portugal relating to researches carried out during the period of 34 years from the commencement of the Institute and the original copies of those patents had not been in the possession of the Institute as well. Out of those, 08 patents had been presented to audit and 04 of them had been obtained in the names of the researchers and it was observed that 03 patents obtained were not available with the Institute.

4.2 Management Activities

The following observations are made.

(a) Even though the Director of the Institute had stated that the agreement entered into in respect of 06 Government quarters at Nilagama, Digana belonging to the Sri Lanka Mahaweli Authority had been obtained for the accommodation of officers employed in the National Institute of Fundamental Studies since the year 1986, action had not been taken to enter into a new agreement by 17 March 2016, the date of audit.

(b) Proper action had not been taken by the Management of the Institute in respect of 105 library books for which information was not made available to confirm the value even by 08 March 2016, the date of audit, misplaced since a period of about 19 years.

(c) Even though a revaluation surplus of Rs.9,167,124 arisen by revaluing 10 motor vehicles in the year under review for a value of Rs.15,955,000 of which the net value was Rs.6,787,876, had been shown in the financial statements, this revaluation had not been carried out by a qualified valuer.

(d) In compliance with the Sri Lanka Public Sector Accounting Standard 03, errors occurred relating to the year 2014 had been retrospectively rectified. As a result, the deficit of values of the year 2014 had been shown in the financial statements for the year under review with an increase of Rs.9,456,482, a decrease of total assets by Rs.7,389,359, an increase of total liabilities by Rs.149,249 and a decrease of equity by Rs.7,538,608. Nevertheless, an approval of the Board of Control had not been obtained for those rectifications.

4.3 Operating Inefficiencies

Action had not been taken even by the end of the year under review to settle 12 advances totalling Rs.280,734 granted by foreign institutions for the purchase of library books, chemicals and other equipment during a period from 09 to 20 years. Action had not been taken to recover those advances from the responsible officers in terms of Financial Regulation 156(1) of the Democratic Socialist Republic of Sri Lanka.

4.4 Transactions of Contentious Nature

The following observations are made.

(a) The "Project relating to the liquid fertilizer called Rhizobium Inoculaint product" for soya beans had been acquired by the National Institute of Fundamental Studies on 31 August 2011 by the Postgraduate Institute of Science and those products had been introduced to the market through 05 external institutions contrary to the functions of the Establishment of National Institute of Fundamental Studies Act. Even though an income of Rs.1,602,300 had been earned therefrom in the year under review, an expenditure of Rs.2,376,967 had to be incurred thereon and as such, a loss of Rs.774,667 had been sustained.

(b) A van of the Institute had been used and spent a sum of Rs. 257,200 for fuel for the daily travel to and from the Digana official quarters by five officers of the staff who are not entitled to transport facility.

4.5 Idle and Underutilized Assets

The following observations are made.

(a) A stock of publications including scientific issues valued at Rs.151,170 published by the Institute for sale 05 years ago had remained idle without being used.

(b) The funds of 10 special grants totalling Rs. 691,257 received from the Government and other private institutions for various workshops and projects of the Institute many years ago had remained idle without being used.

(c) It was observed in audit that computers and printers revalued at Rs. 431,465 remained in an unusable condition from a long period.

4.6 Personnel Administration

Twenty vacancies in 05 posts existed in the cadre of the National Institute of Fundamental Studies and out of them, 11 vacancies in the Research Staff and 04 vacancies of Research Assistants existed. As such, it was observed that there was a hindrance in achieving the expected targets of research activities of the Institute.

4.7 Market Share

Even though the National Institute of Fundamental Studies was in the 13953rd place in the year 2014/2015 according to the ranking of universities of the world, it had descended to the 14894th position by 941 places in the year 2015/2016. Even though it had obtained the 19th position in the year 2014/2015 among the universities of Sri Lanka, in the year 2015/2016 it had descended to the 21st position by 02 places. As such, it is observed that the Institute had failed to secure its graded position and proceed further.

5. Accountability and Good Governance

5.1 Internal Audit

Even though internal audit units should be established in every institution in terms of Financial Regulation 133 of the Democratic Socialist Republic of Sri Lanka, the Internal Audit Unit of the Institute had not been implemented during the year under review.

5.2 Procurement and Contract Procedure

Even though the Chief Accounting Officer should appoint Departmental Procurement Committees in terms of Guideline 2.7 of the Government Procurement Guidelines and Sections of 2.7.5 of the Procurement Manual, contrary to it, the Director of the Institute had appointed the Procurement Committee and purchased fixed assets totalling Rs.34,796,153 and chemicals and glassware totalling Rs.7,113,430 in the year under review on the approval of that Committee.

5.3 Budgetary Control

The annual budget should be made use of as an instrument for the achievement of the long term goals according to the Corporate Plan in terms of Section 5.2 of the Public Enterprises Circular No. PED/12 of 02 June 2003 of the Director General of Public Enterprises. Nevertheless, it was observed that the budget had not been made use of as an effective instrument of financial control due to the following variations.

(a) Variances ranging from 10 to 97 per cent between the estimated expenditure and actual expenditure pertaining to Objects were observed.

(b) Even though provisions amounting to Rs.69,500,000 had been made in the year under review for the construction and rehabilitation of buildings, purchase of computer software and furniture and office equipment for laboratories and for training on capacity building, it was observed that the provisions had not been utilized for those purposes even by June 2016.

6. Systems and Controls

Weaknesses in systems and controls observed during the course of audit were brought to the notice of the Director of the Institute from time to time. Special attention is needed in respect of the following areas of control.

Areas of Systems and Controls	Observations
(a) Accounting	Failure in adhering to Sri Lanka Public Sector Accounting Standards.
(b) Control of Operations	Failure in planning research activities so as to fulfill the objectives of the Institute and to implement them.
(c) Stock Control	Failure in taking action in terms of Financial Regulations relating to slow moving stocks and idle stocks.
(d) Utilization of Vehicles	Non-implementation of a proper internal check due to carrying out all activities in respect of control and repairs of motor vehicles by the one officer.

H. M. Gamini Wijesinghe
Auditor General