



NATIONAL  
SCIENCE  
FOUNDATION



**Development works  
of  
National Science Foundation  
(2017-2019)**



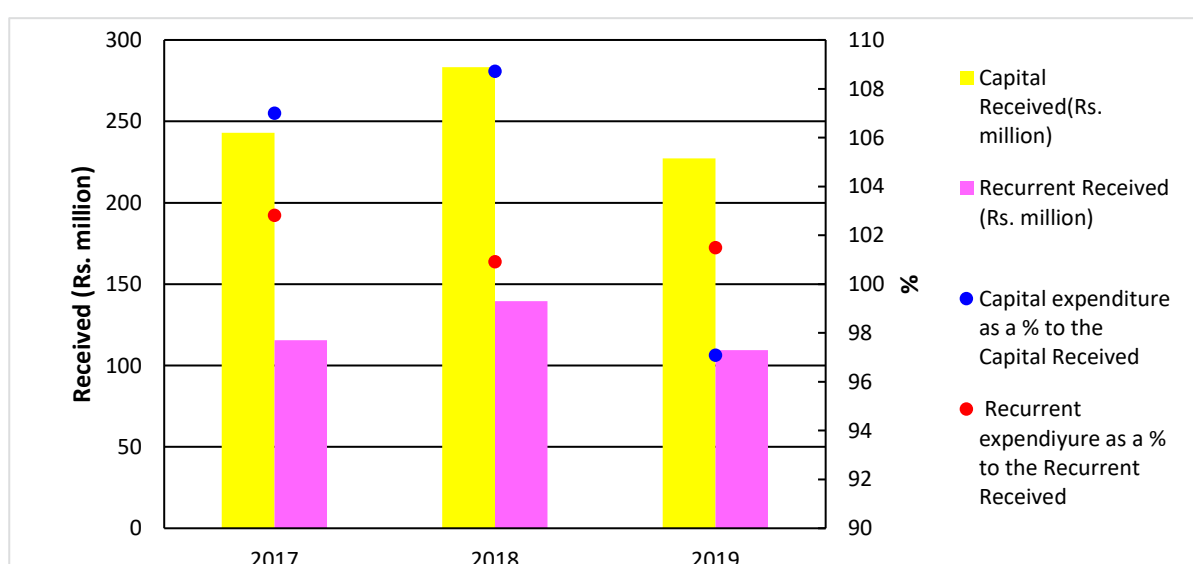
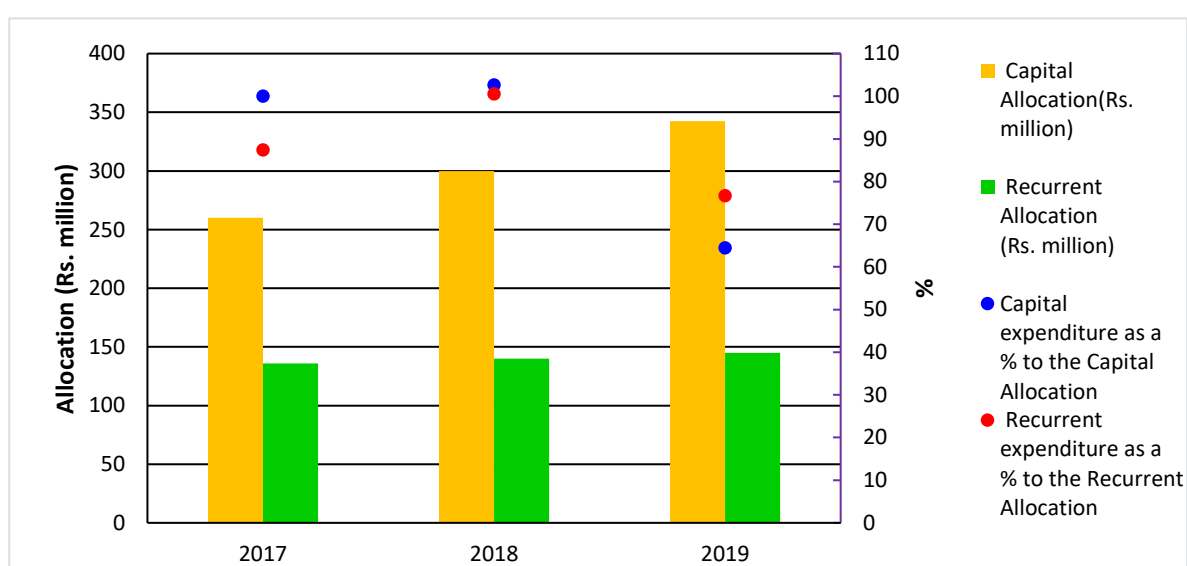
# Contents

<b>1. Capital &amp; recurrent allocated, received from budget 2017 – 2019 &amp; expenditure .....</b>	<b>1</b>
<b>2. Outcome of the expenditure/contribution to national development .....</b>	<b>2</b>
Comprehensive research/technology project details (Research highlights/ commercialized or technology transfers) .....	4
Significant Outputs Arising from Completed Research Projects .....	4
National Thematic Research Programme .....	13
Significant Outputs Arising from Technology Projects .....	18
Research Programme on Health Science (RPHS) project details and highlights .....	26
Special Project on Cinnamon .....	28
<b>3. Highlights of other activities during 2017-2019 .....</b>	<b>29</b>
Interactive workshop on “Converting a draft manuscript to a ‘Ready to Publish manuscript’.....	30
Research Management Workshop .....	30
Identifying Research Gaps in Ocean & Marine Sciences .....	31
FAO-Ministry of Environment Bio safety Project – Special project .....	31
National Research, Development and Innovation (RD&I) Survey .....	32
Science and Technology Management Information System (STMIS) .....	33
Young Social Scientists Forum of the NSF .....	33
Launching of the publication .....	34
International Conference on ‘Social and Cultural Nexus of S&T Development’ .....	34
National Digitization Project .....	35
Progress of the Sri Lanka Journals Online (SLJOL) - 2018 .....	36
Journal of the National Science Foundation (JNSF) .....	37
Sri Lanka Journal of Social Sciences (SLJSS) .....	38

Research collaborations with International bodies .....	38
German Research Foundation (GRF) .....	38
Establishing the partnership with ICSSR .....	38
National Natural Science Foundation, China (NSFC) .....	39
Memorandum of Cooperation with the Japan Science and Technology Agency (JST)	39
Meeting with the Global Research Council (GRC) .....	40
German Academic Exchange Service (DAAD) .....	40
International Science Council – Stakeholder meeting on urban studies .....	41
First meeting of Sakura Science Club Alumni Association Sri Lanka (SSCAASL) .....	41
An Awareness Programme on the NSF-DAAD Project based Personnel Exchange Programme (PPP)..	42
Meeting with the Vice President of the National Natural Science Foundation, China (NSFC) .....	42
International Center for Genetic Engineering and Biotechnology –	
Regional Research Center (ICGEB-RRC) .....	42
Meeting on Bilateral Scientific Cooperation with the German Ambassador .....	43
Meeting on Bilateral Scientific Cooperation with South Africa .....	43
Knowledge Sharing Programmes (KSP) .....	43
Inculcating a research culture amongst the school children .....	44
Sri Lanka Science and Engineering Fair (SLSEF) .....	44
Intel International Science and Engineering Fair (Intel ISEF) .....	44
Annual Report 2017 .....	46

## 1. Capital & recurrent allocated, received from budget 2017 – 2019 & expenditure

Year	Allocation Capital (Rs. million)	Allocation Recurrent (Rs. million)	Capital Received (Rs. million)	Recurrent Received (Rs. million)	Expenditure Capital (Rs. million)	Expenditure Recurrent (Rs. million)
2017	260	136	243	115.59	260	118.85
2018	300	140	283.31	139.50	308	140.78
2019 (Up to September 30 <sup>th</sup> )	342.3	145	227.19	109.53	220.56	111.17



## 2. Outcome of the expenditure/contribution to national development

**Table 1: Expenditure**

Grant Scheme	2017		2018		2019	
	No of Grants	Total Cost (Rs. million)	No of Grants	Total Cost (Rs. million)	No of Grants	Total Cost (Rs. million)
Competitive Research Grants (CRG) and ICRP	95	62.64	89	73.03	83	67.77
National Thematic Research Programme (NTRP)	-	-	04	17.64	05	21.2
Research Equipment (EQ) & spareparts (SPR)	17	45.56	07	5.67	03	7.55
Technology Grants	28	15.95	22	23.64	13	25.4
NSF Scheme on Funding Page Charges	04	0.22	08	0.64	07	0.761
Overseas Science Education Programme	05	0.08	16	1.52	30	3.5
Research Scholarships	14	13.26	20	26.59	25	20.65
Support Scheme for Scientific Meetings and Events	37	24.49	34	18.82	22	6.367
International Travel Grants	60	12.48	58	10.13	33	5.64
Overseas Special Training Programme (OSTP)	38	14.57	21	7.63	20	7.01
International Partnerships for Science and Technology (IPSAT)	10	4.2	08	3.7	04	2.3
Post-Doctoral Research Scientist Grant	01	1.69	01	1.59	01	1.20

**Table 2: Status summary of grants awarded**

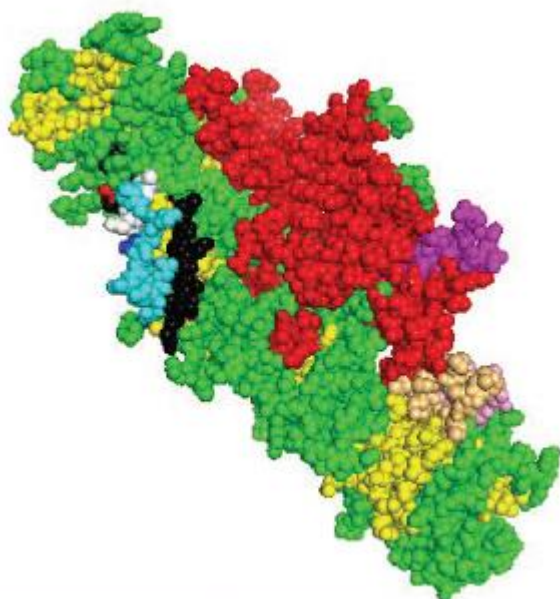
Grant Scheme	2017			2018			2019		
	No of Grants Awarded	No of Grants Completed	No of Ongoing Grants	No of Grants Awarded	No of Grants Completed	No of Ongoing Grants	No of Grants Awarded	No of Grants Completed	No of Ongoing Grants
Competitive Research Grants	23	43	95	05	17	83	10	12	81
National Thematic Research Programme	-	09	-	04	-	04	01	-	05
Research Equipment (EQ) & spareparts (SPR)	17			07			03		
Technology Grants	08	08	28	01	22	08	-	05	13
NSF Scheme on Funding Page Charges	04			08			07		
Overseas Science Education Programme	05			16			30		
Research Scholarships	10	05	14	11	05	20	08	03	25
Support Scheme for Scientific Meetings and Events	37			34			22		
Travel Grants	60			58			33		
OSTP Grants	38			21			20		
IPSAT Grants	10			08			04		
Post Doctoral Research Scientist Grant	01			01			01		

## Comprehensive research/technology project details (Research highlights/commercialized or technology transfers)

### Significant Outputs Arising from Completed Research Projects

#### Development of a vaccine candidate with a broadly reactive neutralizing immune response against dengue

This study proposed an alternative strategy to the commonly used tetravalent-type vaccine design strategy to focus on conserved epitopes and therefore, aimed to identify a conserved DENV protein epitope that elicit broadly cross-reactive and neutralizing antibodies during natural dengue infections. The findings of this study have practical applications. The identified broadly immunogenic neutralizing epitopes appear as promising candidates for an epitope based vaccine. The characterization of this vaccine candidate with animal testing, clinical trials and GMP standards will lead to establish a novel vaccine for dengue. This will contribute to uplift the pharmaceutical capacity of the country. At the same time serotype specific peptides identified during this study could be applied as an ELISA based diagnostic marker for identifying the dengue serotype of infection that can be used as a user-friendly low cost method in diagnostic laboratories.



*The locations of the broadly immunogenic neutralizing E protein epitopes on DENV E protein (PDB 3J2P)*

#### Cloning and expression of cellulase and xylanase genes of *Trichoderma* in a yeast system to develop synergistic saccharification and direct fermentation of cellulosic biomass to ethanol

Ethanol production using cellulose and hemicelluloses such as endoxylanases, the major component of plant biomass has been selected as a key area for R&D in many countries. This study was carried out with the objective to express the cellulase and xylanase genes in yeast to develop a recombinant yeast system, harbouring cellulase and xylanase genes, capable of direct ethanol production from lignocellulosic biomass.



The findings of the project can lead to both industrial scale ethanol production and cellulose and xylanase enzyme production. This can be applied in various other industries such as textile, brewery, food and feed and agriculture.

#### **Studies on cryopreservation of embryogenic callus from unfertilized ovaries using the encapsulation – dehydration technique and post thaw plant regeneration in coconut (*Cocos nucifera* L.)**

Coconut seed does not have a dormancy period thus limiting the conventional storage. This study was carried out with the objective to develop a reliable cryopreservation technique, which is the only viable option available for the long-term conservation of germplasm for coconut using unfertilized ovary derived embryogenic callus.

The findings of the present study showed the feasibility of using coconut embryogenic calli for the purpose of cryopreservation. This is the first report on using coconut embryogenic calli for the long-term storage of coconut germplasm. The research findings will support developing a new *in-vitro* conservation method for coconut and this will enable conserving precious germplasm for future use.

#### **Molecular characterization of bacteria involved in bioremediation of heavy metals and elucidation of possible bioremediation mechanism**

Toxic effect of heavy metal contamination has become a major threat to public health and environment. Bioremediation is the process of using microorganisms to remove pollutants. This research was conducted with the aim of characterizing bacterial strains involved in bioremediation from effluent samples collected from textile dyeing industry and study of possible mechanism of metal tolerance. The findings of this research will help to find the mechanism behind the metal tolerance of bacterial strains. The data obtained in this study will benefit further studies in metal resistance genes which have not studied in detail. The identified bacterial strains showed significant metal tolerance and resistance to metal ions and also have shown metal uptake from the medium with time. As such, this can be used as a potential tool for heavy metal bioremediation after studying pathogenicity and other virulence factors.

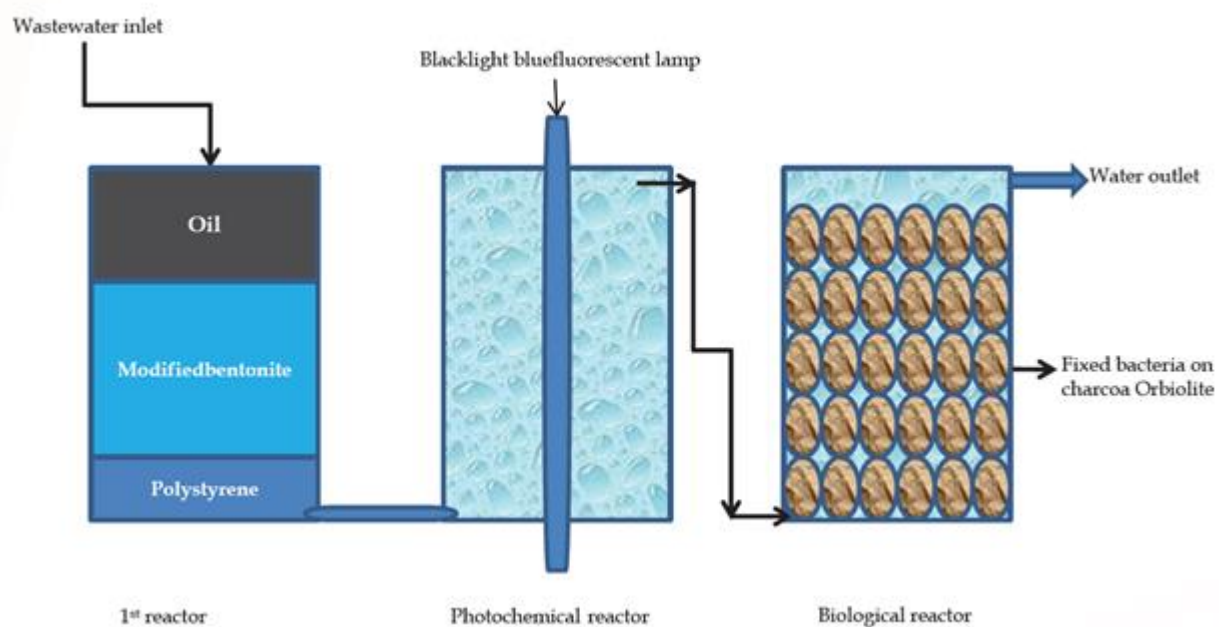
#### **Formulation of therapeutic probiotic foods as an alternative treatment for *Helicobacter pylori* infection conditions**

More than 50% of the world's population is infected with *Helicobacter pylori*, the main causative organism for gastric and peptic ulcers, gastric cancers or mucosa associated lymphoid tissue (MALT) lymphoma. Currently, this infection is treated with antibiotics along with proton pump inhibitors which lead to several side effects. This research was conducted to isolate and characterize probiotic bacteria with anti *Helicobacter pylori* activity, from selected food sources to develop a functionally active food (beverage) that can be used as an alternative treatment of *H. pylori* induced gastric ulcers. Rice varieties such as *Suwadhel*, *Madathawalu*, *Sudukekulu*, *Rathukekulu*, *Basmathi*, *barley* and *coconut milk* were used as the source to isolate probiotic bacteria. *Pediococcus pentosaceus* which is isolated from *Madathawalu* rice was the most potential probiotic candidate with anti *H. pylori* activity based on joint FAO/WHO Working Group Guidelines. This is an initiation to develop therapeutic food using locally isolated strains and local raw material.

## Design of Biological and Advanced Oxidation Technology (AOT) hybrid reactor system for oil wastewater treatment

Automobile service station wastewater has been a heavy environment pollutant and a major topic of environment science fields. The service station wastewater pollutes surface water sources as well as ground water sources. Water treatment and purification was accomplished through a variety of chemical and physical separation techniques. However, it is well known that in Sri Lanka, most of the industries and especially service stations do not have proper wastewater treatment plants owing to high operational cost. Hence, considering the environmental impact, introduction of on-site, cheap water treatment plant for the small-scale industries is very timely.

As the outputs of this study, laboratory scale affordable reactor that has preliminary physical adsorption reactor, a chemical reactor and a biological reactor was developed for the purification of oily wastewater from service stations. The filters that have been developed are cheap and easy to handle, while it could effectively separate water from the different oil-water mixtures. The findings of this research have impacts on socio-economic development of the country, as treatment of oily wastewater makes it possible to recycle the water, reducing the cost of water requirement in the industry. The research findings also improve well-being of the people through controlling water pollution which threaten the biodiversity and healthy living.



*Schematic diagram of a full running coupled reactor*

## Vitamin A and iron status among pregnant mothers and their offspring in an urban area of Sri Lanka

Anaemia is the most common nutritional problem in pregnant mothers. Iron deficiency is a major cause of anaemia during pregnancy and recent evidence suggests that it can be a cause for poor cognitive performance and development in infants. This study was conducted to assess and compare the status of anaemia, iron and vitamin A in women before and after micronutrient supplementation during pregnancy, as per the national maternal health programme of Sri Lanka and to assess the effect of postpartum vitamin A mega dose supplementation among pregnant mothers and their offspring.

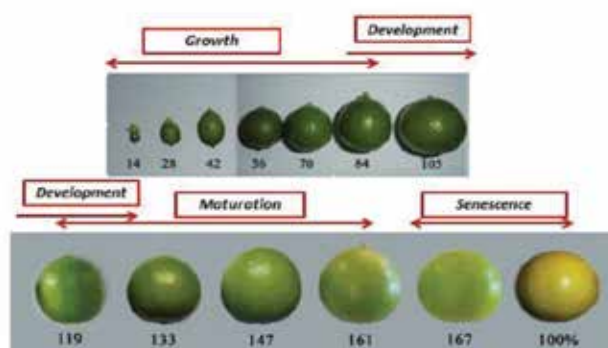
The results indicate that more than 50% of pregnant mothers begin their pregnancy with iron deficiency and are undiagnosed in antenatal screening. The findings of this study help to evaluate the current national maternal health programme and modification of the micronutrient supplementation in pregnant women. The Ministry of Health has also agreed in principal to use serum ferritin instead of haemoglobin in national screening programmes for anaemia based on the study results. The research outcomes will help improve the health of pregnant women and their offspring which will ultimately improve the health and well-being of the society.

## Investigation of fruit phenology and pre-harvest foliar treatment of growth regulators on fruit quality and post-harvest life of lime (*Citrus aurantifolia* Swingle)

There is a constant demand for fresh lime throughout the year as it is used for various domestic and industrial purposes as well as in indigenous medicine. A scientific study on this high priority crop has not been carried out to address pre and post-harvest issues of the crop. This research aimed at studying fruit phenology, maturity manipulation, fruit season and development of appropriate storage strategies for year-round marketing.

Post-harvest life of lime fruits were evaluated and the results showed significant differences in physiological weight loss (PWL), visual quality rating, peel lightness (L\*) and hue (ho) values in maturity stages during the storage period. In conclusion, post-harvest life of lime fruits harvested at 119, 147 and 161 days after fruit set (DAFS) were 6, 7 and 3 days, respectively whereas marketable life of fruits harvested at 133 DAFS was 9 days under ambient storage conditions (30 - 34 OC, 70 - 75% Relative Humidity (RH)). Based on the experiments the research team developed a color chart that can be used by lime growers to identify the best harvesting maturity on the peel color.

*Variation in phenological stages of lime (C. aurantifolia Swingle) fruit (14, 28 etc. are days after fruit set*

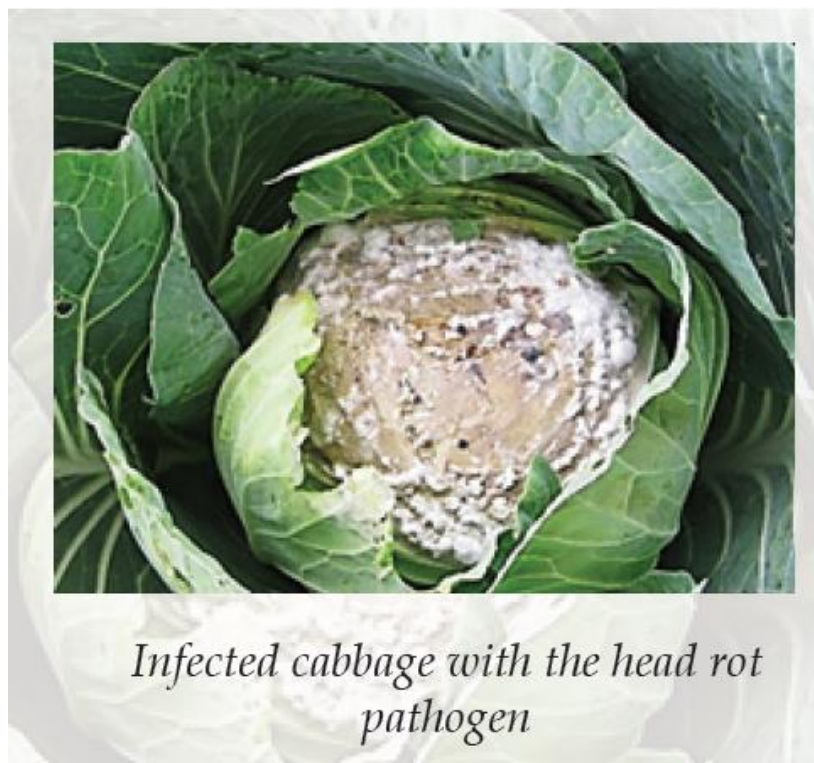


### **Screening, isolation and characterization of type II restriction enzymes from bacteria isolated from different regions of Sri Lanka**

This study proposed isolation and characterization of restriction enzymes from bacteria isolated from different regions and habitats of Sri Lanka. Screening of bacteria led to isolation of 09 restriction enzyme producing bacterial strains. Based on the isolation and characterization, two restriction enzymes were selected as suitable for further analysis. The putative genes for these restriction enzymes were identified. Further, analysis on large scale production of recombinant enzymes has to be explored and characterization of restriction enzymes from other bacterial isolates is to be done with a view of commercialization. The findings of this study have practical applications.

### **Genetic diversity and management of cabbage white mold pathogen, *Sclerotinia sclerotorum*, and feasibility of Anaerobic Soil Disinfestations (ASD) and Bio-Fumigation (BF) based disease management for upcountry vegetable production system**

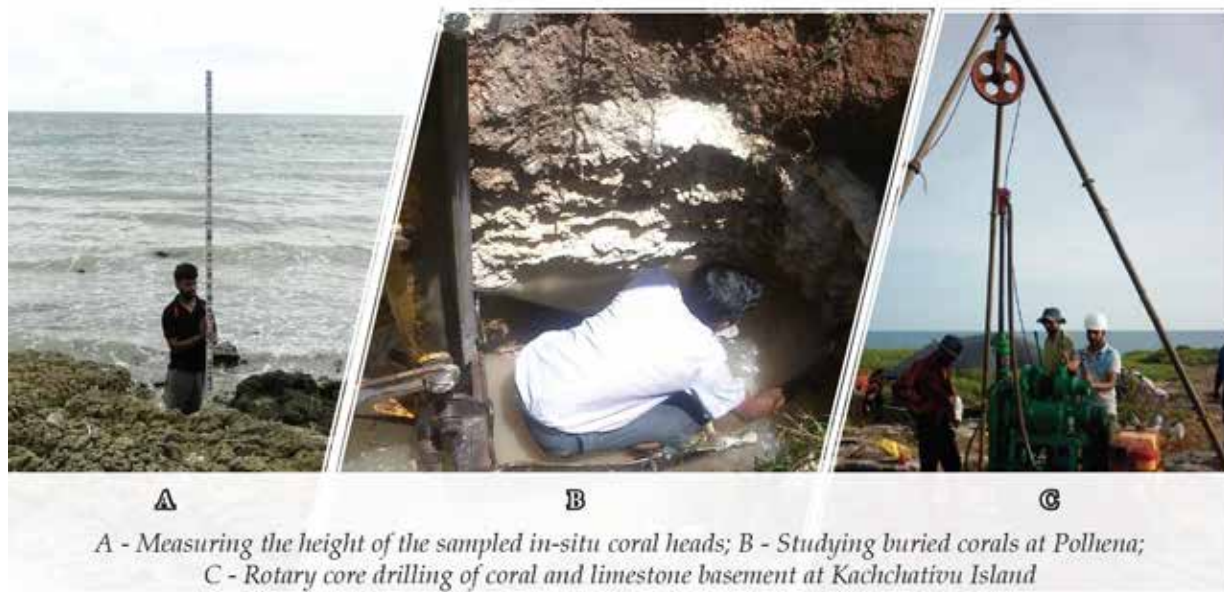
This project focused on determination of population genetic diversity and feasibility of Anaerobic Soil Disinfestation (ASD) in disease management in Sri Lanka. High genetic diversity was detected and ASD was effective in managing the pathogen survival structures. The project generated new knowledge on pathogen genetics, behavior and introduced potential eco-friendly management strategies for the first time in Sri Lanka. This research also found a high potential of cross resistance development in Sri Lanka for commonly applied fungicides.



## Constructing quaternary sea-level curve for Sri Lanka

Understanding long-term sea-level variability is the key to recognizing future variability. Main objectives of the research were to contribute to developing a long sea level record for the Central Indian Ocean and identification of forcing mechanisms.

According to the results, three phases of island formation during the Miocene, Pleistocene, and Holocene could be recognized in the Palk Strait area. Changes in sea level have resulted in these island formations. It was recognized that future anthropogenic sea level rise could submerge a large area of coastal lowlands in the south and in the Jaffna peninsula. This study also glimpsed the coastal landscape changes at the anthropogenic sea level rise. According to the gathered data, coastal lowlands including Jaffna peninsula will be at risk with the rising sea level. This information can be used for urban planning and coastal zone management. Modelling the coastal areas with accurate levelling data is essential to predict flooding areas at different levels of sea level rise in future.



## Identification of clinically significant Mycobacterium other than tuberculosis (MOTT) species, assessment of invitro drug susceptibility, development of a rapid ELISA based identification method

Non-tuberculosis Mycobacteria (NTM) causes pulmonary disease which is often chronic and occurs in older people or those with underlying lung diseases. More attention is always paid to the diagnosis of diseases caused by *M. tuberculosis* complex and not for NTM. However, there are increased numbers of reports of infections caused by NTM. Therefore, accurate identification of species is vital for individual patient management with the correct antibacterial treatment. Seventy-eight NTM species were identified from the specimens collected during the study. Antibiotic susceptibility testing was also carried out and drug resistance was identified. Further work is being carried out to develop an assay for identification of NTM.

### **Studies on prognostic markers of oxidative stress and its host genetic polymorphisms and endothelial dysfunction in severe dengue infection**

This study was conducted to assess serum biomarkers for early detection of severe dengue infection and to understand the pathological mechanisms involved. Several potential biomarkers were identified through the study. Serum NOx levels in the early stages of the disease was identified as an important prognostic indicator.

### **Effect of endocrine disruptor Mancozeb on oviductal/fallopian tube proteome and Secretome**

Mancozeb is a fungicide which is very commonly used in Sri Lankan agriculture sector. Recently, based on scientific evidence, Mancozeb has been identified as an endocrine disrupting chemical. In Sri Lanka, Mancozeb use is very high and quite often the farmers misuse it and therefore, heavy doses of Mancozeb gets into the environment. Endocrine disruptors have been alleged as one of the causes of sub-fertility and infertility which is increasing all over the world. This study was conducted to find the effect of Mancozeb on the oviduct/ fallopian tube.

In vitro cell culture-based assays and in vivo mice studies were carried out and the data suggest a direct disruptive impact on oviductal functions. Hence, Mancozeb was found to cause the loss of pregnancy leading to sub-fertility and infertility.

### **Assessment of potential human and ecosystem health risk imposed by atmospheric particulates in Kandy, Sri Lanka**

This study focused on different types of pollutants, inorganic, organic and biological. The results indicated the level of pollution of Kandy city by heavy metals (HMs), microbes and polycyclic aromatic hydrocarbons (PAHs). There is a risk associated with children exposed to HMs. Further studies are required on how to mitigate and to control pollution due to these agents. Results of this study open avenues for policy makers and administrators to plan and implement pollution mitigation actions.

### **Purification of graphite of Sri Lanka as a high value addition**

The method of purification of graphite utilized in this project is called acid/alkali method. During the functions, impurities react with NaOH and H<sub>2</sub>SO<sub>4</sub> causing turning into soluble chlorides and sulphates which are washed with water for removal. This method needs less investment and is easy for implementation.

The purified graphite is widely applied in manufacturing of highly value-added materials such as graphite oxide and reduced graphene oxide. The value of graphene prepared from high purity graphite exceeds the value that is made out from natural graphite. Beneficiation of graphite concentrate to a 99%-plus purity level is essential for use in lithium-ion batteries and for other high technology applications. For example, semiconductor technology demands constant innovation and ultra-high-purity materials from suppliers. Products made from high-purity fine-grain graphite meet these requirements. Development of materials for wafer

production processes and coatings enhance the purity of the next semiconductor generation, while extending the service-life of materials at the same time. The results will lead to technology transfer of the invention to natural graphite exporters in Sri Lanka and patent applications have been submitted for innovative materials and processes.

**Survey on the occurrence and nest density of *Aneuretus simoni* Emery (Family: Formicidae) and associated ant fauna in a selected forest in Colombo and Kegalle Districts and preparation of a preliminary ant inventory of each forest**

The Sri Lankan Relict ant was recorded as a critically endangered or endangered by the IUCN and “RED listing 2012” in Sri Lanka. Current findings have added two more newfound habitats of *Aneuretus simoni* (with considerable nest densities in dry and rainy months) indicating the necessity to re-evaluate its status in Sri Lanka.

Conservation of biodiversity is a major need at the national level and Indikada Mukalana Forest Reserve and Lenagala Forest Reserve should be maintained as forest reserves in the future to conserve this globally rare ant species.

One PhD degree was completed and two full papers and 7 communications were published.

**Micronutrient status, obesity related biomarkers of inflammation, cardiometabolic risk markers and body composition in pre-pubertal school children**

Correlation between percentage body fat and anthropometric measures were established.

This study produced new data on body composition in young children along with cardiometabolic risk and micronutrient status.

6 communications were published.

**A comprehensive study on the anti-inflammatory and antimicrobial secondary metabolites in selected medicinal plants**

This study revealed an extremely potent anti-inflammatory and antimicrobial activity in *P. zeylanicus* along with a conspicuous anti-inflammatory potential in *H. furcatus*, *L. zeylanica* and *P. scandens*. Although the antimicrobial potential in other plants is negligible, the findings for the lipophilic extracts of *P. zeylanicus* and its secondary metabolites are highly promising and could direct towards the development of herbal disinfectant to combat nosocomial infections.

One full paper and 7 communications were published.

**Synthesis and characterization of structure property correlation of biomass (lignin) based polyurethane foams as a replacement for petrochemical based foams use in Sri Lanka**

This study revealed that the lignin extracted from coconut sawdust can be used to replace petrochemical based diols used in polyurethane industries in Sri Lanka.

2 communications were published.

### **Non-intrusive load monitoring for flexible demand estimation and management**

The algorithms developed has the proven ability to function as a standalone system providing the user and the utility with the details of appliance usage in a customer premises in real-time and it also possesses the ability of further advancement into a tool of predication, demand side management, and distributed renewable generation management. This operational philosophy helps the addition of renewable energy sources thus reducing the dependency on imported fossil fuel.

2 full papers and 4 communications published.

### **Investigation of Mud-concrete for in-sit cast load bearing walls**

Self-compacting in-situ cast Mud-Concrete load bearing walling system was developed through locally available materials. It is a low cost, quick and sustainable construction technology.

This system can lead to sustainable green construction, climate sensitive architectural designs and low-cost mass housing projects while tremendously contributing to saving the environment, energy and the capital expenditure of the country.

One PhD degree was completed. One full paper and 11 communications were published.

### **Growth and Phosphorus (P) nutrition diversity of Sri Lankan and introduced rice varieties at variable soil P supply and adaptations to increase the P uptake and use-efficiency when grown in P impoverished soils**

Rice cultivars which showed promise in the growth under low-P conditions can be recommended to grow in low fertile soils. Under any restriction of P fertilizer importation and/or application, selected varieties can be used to minimize risk.

Information/data generated are quite useful in future rice breeding programs.

One PhD degree, one full paper and 2 communications were produced.

**Table 3: Patents arising from grants**

<b>Patent Count &amp; Grant No:</b>	<b>Patent Number</b>	<b>Invention</b>
02 RG/2015/EA&ICT/02	18762 18879	Self-compacting in-situ cast Mud-Concrete load-bearing walls Modular Formwork system for in-situ cast walls made out of self-compacting soil-based materials
01 RG/2012/HS/01	Pending	Therapeutic agent for Pre-diabetics comprising of zinc sulphate compound
02 RG/2014/BT/03	Pending	A diagnostic marker for specific identification of the four dengue viruses
01 RG/2016/EA&ICT/01	Pending	Real time non-intrusive appliance load monitoring under supply voltage fluctuations



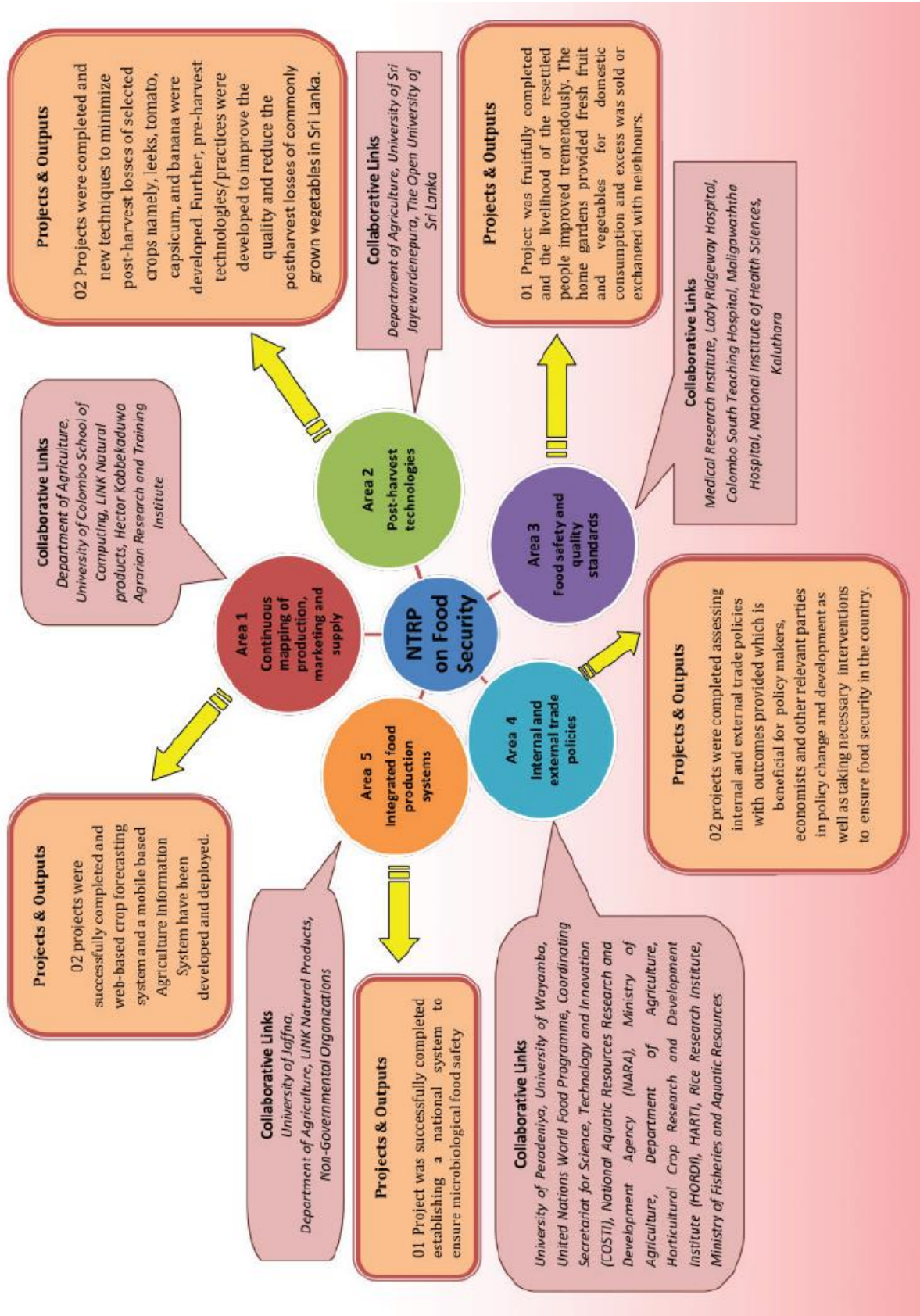
## **National Thematic Research Programme**

The NSF initiated the contract research programme to address immediate national needs for socio-economic development of the country under four themes; Food security, Climate Change & Natural Disaster, Water security, and Energy in 2010. The work on three themes; Food security, Climate Change & Natural Disaster and Water Security were initiated subsequently.

### ***NTRP - Food Security***

The NTRP on Food Security was the first contract research initiated under NTRP. The first phase of the Food Security Programme was successfully concluded achieving most of its objectives. Some projects yielded significant outputs towards socio-economic development of the country. Several projects produced publications as well as conference presentations thus disseminating new knowledge to the S&T community. Nine projects were in progress focusing five specific areas during the span of the Food Security Programme. This was a successful collaborative effort of 70 scientists from 21 institutes.

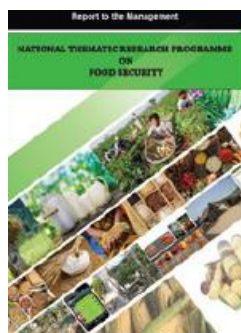
The following *diagram* depicts the geographical areas of the country benefitted by the “Food Security” programme.



The summary of the completed grants are as follows.

Programme	Grant No	Project title
<b>Area 1</b>	NTRP/2012/FS/PG-01/P-01	Development of a web-based crop forecasting system in Sri Lanka
	NTRP/2012/FS/PG-01/P-02	A social Life Network to enable farmers to meet the varying food demands of the population, by providing needed information just in time (real time basis) and better monitoring and management of crop production
<b>Area 2</b>	NTRP/2013/FS/PG-02/P-01	Application of novel techniques to minimize postharvest losses of five selected fruit and vegetable varieties
	NTRP/2013/FS/PG-02/P-02	Food Security through Adoption of Pre-harvest Technologies: Improving Quality of Fresh Produce by soil application of potassium and Silicon
<b>Area 3</b>	NTRP/2012/FS/PG-03/P-01	Establishing a national system for ensuring microbiological food safety
<b>Area 4</b>	NTRP/2012/FS/PG-04/P-02	Assessing internal and External Trade Policies and Practices affecting food security in Sri Lanka, and identifying areas for improvement
	NTRP/2012/FS/PG-04/P-01	A study of supply and price behavior relating to Selected Crops and Livestock products in Sri Lanka
<b>Area 5</b>	NTRP/2012/FS/PG-05/P-01	Development of sustainable integrated food production systems to enhance household food and nutritional security, economic growth and livelihood of resource poor families in the Northern Region of Sri Lanka
	NTRP/2012/FS/PG-054/P-02	Development of Household Food Security models for poverty-stricken areas of Sri Lanka

A comprehensive final report on the NTRP (Food Security) includes the inception, theme paper, process of awarding, monitoring, outputs, recommendations and constraints faced during different phases of the Programme. It is expected that this report will serve as a guide to the future NTR Programmes of the NSF.



Follow up activities done to disseminate the outputs of the programme:

- Discussions with grantees to finalize the output dissemination plan.
- Planning to initiate the 2nd phase of the programme in 2019 was in progress. Accordingly, a discussion was held with the Food and Agriculture Organization (FAO) and a concept paper titled “Development of a Food Safety Monitoring System for Sri Lanka” was prepared for consideration.
- Stakeholder discussions with Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) and the Dept. of Agriculture and handing over the source code and the software developed by the University of Colombo School of Computing (UCSC).

This mobile App provides a unique opportunity to farmers on an individual basis, to cultivate and market the required crops in a cost-effective way in any desired geographical location. It can be installed on a smart phone which can provide real-time information for selecting crop varieties suitable for a given location, estimate the cost of production based on information on fertilizer and pesticide requirements and their present market price, view prices being offered to a particular crop in and around the site of cultivation, and even get advice from relevant authorities in case of a pest or a disease.

#### **NTRP - *Climate Change and Natural Disasters***

The NTRP on Climate Change & Natural Disasters (CC & ND) was implemented to address major issues through research, with a view to minimizing hazards of Climate Change & Natural Disasters through mitigation and adaptation. Four projects were awarded in 2017 and continued during 2018.

The Second Research Coordination Meeting (RCM) to monitor the progress of the four projects was held on 19th December 2018. The invitees represented the Climate Change Secretariat, National Planning Department, Department of Agriculture, Department of Forest Conservation, Department of Meteorology, Hector Kobbakaduwa Agrarian Research and Training Institute and Disaster Management Centre.

#### **NTRP - *Water Security***

The activities pertaining to the theme Water Security was initiated in the middle of 2018. An Expert Panel consisting eminent scientists in water and related areas was appointed to work on the theme. Stakeholder discussions were conducted at Mahaweli Authority, Central Environmental Authority, Irrigation Department and Ministry of Irrigation. A proposal was developed to be submitted to the National Planning Department seeking funds to implement the NTRP Water Security programme.

**Table 4: Technology transfers/ commercialized from 2017-2019**

Year	Field	No. of Technologies Transferred/ Commercialized			Name of the Industry	
		R & D in progress	TT in progress	Commercialized		
2017	Agriculture		1		Department of Agriculture	
	Waste Management			1	Sanasuma polythene/plastic Recycling Centre	
	Biotechnology		1		Ceygen Biotech (Pvt) Ltd	
	Mech. Engineering		1		ARA Engineering, Eheliyagoda	
2018	Medical	6			University of Moratuwa	
					University of Colombo	
					University of Sri Jayewardenepura	
					Jendo Innovations	
					East Link (Pvt) Ltd.	
					Anti-Leprosy Campaign	
	Education	3				University of Colombo
						University of Sri Jayewardenepura
						University of Ruhuna
	Textile	1				University of Peradeniya
	Fertilizer	2				Individual Inventor
						University of Peradeniya
	Tea	1				Tea Research Institute
	Polymer	1				Samson Compounds (Pvt) Ltd.
	Automobile Industry	3				ART Logistics (Pvt) Ltd.
						Individual Inventors – 2
	Mineral Industry	1				University of Peradeniya
	Gem & Jewelry Industry	1				Gems and Jewelry Research and Training Centre
	Food and Beverage	2				Lily Cheese (Pvt) Ltd
University of Sri Jayewardenepura						
Waste Management	1				Individual Inventor	
Boat building Industry	1				University of Ruhuna	
Water treatment	1				Individual Inventor	
Waste Management	1				National Institute of Fundamental Studies	
Construction Industry	1				Individual Inventor	
2019	Medical	1	1	1	University of Moratuwa (R&D -1, TT-1)	
	Education	1	1		East Link (Pvt) Ltd.	
	Textile	1			University of Peradeniya	
	Agriculture					
	Mineral Industry	1			University of Peradeniya	

	Gem & Jewelry Industry	1		1	Gems and Jewelry Research and Training Centre
	Food and Beverage Industry	1		1	University of Sri Jayewardenepura (R& D), Lily Cheese (Pvt) Ltd -CC
	Fertilizer			1	Individual Inventor
	Boat & Ship building Industry		1		University of Ruhuna
	Water treatment	1			Individual Inventor
	Waste management	1			National Institute of Fundamental Studies
	Construction Industry	1			Individual Inventor

## Significant Outputs Arising from Technology Projects

### Locally developed DNA extraction kits

Communicable and non-communicable diseases such as tuberculosis, malaria, HIV, hepatitis B & C, dengue, thalassaemia, different leukemia types and tumors take a significant toll on the population and it is a huge burden to the economy. Misdiagnosis and wrong treatment not only increases cost of treatment but also lead to increased morbidity and mortality. Molecular diagnosis is an effective tool which can be used for accurate diagnosis of the said diseases. However, use of molecular diagnostic techniques has limitations due to high cost of imported test kits and reagents. National Science Foundation provided financial support to Ceygen Biotech (Pvt) Ltd., a Sri Lankan Start-up company in the field of Biotechnology to manufacture genomic DNA extraction kits, viral RNA extraction kits and recombinant enzymes locally with a five-fold cost reduction in products than importing the test kits, thus enabling patients to access to effective diagnostic techniques at an affordable cost.

The Ceygen Biotech products have now reached the market as viable substitutes for imports. It has been forecasted by the company that the total estimated saving to the country within next five years will be Rs 75 Mn.



### Wireless pad-based vehicle weighing system

Wireless pad-based vehicle weighing system is a low cost, portable and minimum space consuming alternative for conventional weigh bridges used across Sri Lanka which are expensive, immobile and needs lots of space. The new system can be set up at an ad-hoc location to load the vehicle on to the pads. The number of pads can be increased to suit with the number of wheels the vehicle have. All the weigh pads are connected to central display unit wirelessly in which the total weight of the vehicle is displayed. The outcome of the project is a prototype of the above described system which can be used to measure the weight of four wheeled vehicles. The developed system would be greatly beneficial to industrial and commercial users who need accurate weight of vehicles and goods they carry. The potential customer base includes; plantation sector (tea estates), good transporters (in ports), commercial dry goods collectors and distributors, authorities to enforce weigh limits of loaded vehicles (Road Development Authority, Sri Lanka Police Department).

### Biological control of cabbage pests

Safe food for consumption and unpolluted environment are very important factors of human life. Crop cultivations with indiscriminate use of synthetic insecticides results in unsafe food, high cost of production, environment pollution, persistence and building up of insect resistance to insecticides. Among vegetables, cabbage crop is being sprayed with chemical insecticides, over and above the recommended rate and time of application for insect pest management, pose a severe threat to human life and environment. Biological insect pest management is a safe and sound alternative method for insect pest management and for Cabbage, crop insect pest management was successfully carried out by using parasitoid *Cotesia plutellae*. Parasitoids were reared at Plant Quarantine Unit laboratory of Department of Agriculture at Gannoruwa, Peradeniya. More than 150 field releases for open field cultivations, poly-tunnels and organic farms were carried out for about 50 ha in the three districts; Kandy, Nuwara Eliya and Anuradhapura. The financial benefit to the farmer through use of biological pest management for cabbage using parasitoid, *Cotesia plutellae*, is calculated as Rs. 103,555.00/ha/crop cycle. Technology transfer programmes are planned to disseminate and transfer the technology to local farmers and industry.



### Eco-friendly helmet

Eco-friendly helmet is manufactured by naturally available materials; different coir types and natural rubber latex as binding agent. The product is introduced as a solution to plastic helmets to give bouncing effect as impacts and it provides comfort to wearer. This helmet is categorized as “Class C- hard helmet” and recommended to be used in civil works at construction sites. This project output will enable coir industry to find a way for a new value added product and thereby to gain economic returns from waste material. In addition, eco-friendly helmet can be introduced to the market as a competitive product against traditional plastic helmets. The eco- friendly helmet can be marketed at its basic form at a price of Rs.300/- and there is a great potential to increase the price with added features on customer demand.



### Smart device for power restoration

A system for fault detection, isolation and restoration using a multiagent-based distribution was developed to overcome the issues pertaining to sudden power interruptions in the distribution network. A multi-layered agent based smart power device system will be a suitable alternative to address the issues of the conventional smart grid and introduce extra level of data process and reliability. This system reduces service restoration time for a permanent fault contingency of distribution feeders which raises the quality for a higher status comparing the existing system.

The online current and power monitoring system is useful to the distribution company to monitor the real-time data. Department of Electrical Engineering, University of Moratuwa is planning to sign an MOU with LECO for implementation of Microgrid Pilot Project and Smart Grid Laboratory, considering the success of this project.





### Improved paddle thresher

Paddle threshers are being used in Rice Research Institutes to thresh paddy during variety based research trials. Rice processing with the existing paddle threshers is strenuous, hard and paddy is not properly threshed. Further, it is difficult to maintain variety wise quality seed collection. The improved machine consists following features,

1. A drawer to collect threshed paddy and the outer cover for the machine to avoid spreading of paddy all over the ground supporting variety-wise collection without mixing.
2. Operation is convenient where the operator can lean on the machine and feed the reap paddy while paddling.
3. Specially designed hooks will help to avoid breaking of panicles into small branches improving threshing quality.
4. Easy to clean by opening the covering lid.
5. Lighter in weight and portable

Other Rice Research Stations and small scale terrace paddy farmers will be benefitted with the newly designed paddle thresher.



### Coconut de-husking machine

An efficient semi-automated coconut de-husking machine was developed under this project. Coconut can be loaded from the top of the machine and de-husked coconut can be collected from the bottom part of the machine. This machine has capability of de-husking a coconut within 10- 15 seconds. Coconut and coconut related industry is having a problem of labour shortage for de-husking coconut. The industry cannot cater to the demand due to this limitation. Coconut industry will enable to enhance output with this new machine mitigating the said limitation.



### **Design and construction of remotely operated under water vehicles (ROV)**

A functional prototype of Remotely Operated underwater Vehicle (ROV) was developed under the project. ROVs are used for a variety of underwater operations particularly in situations when it is not practically possible or when it is unsafe for a person to go and perform a task personally. The grantees are working jointly with the R&D Division of the Sri Lanka Navy for further improvement. Accordingly, this project will pave the way forward in Sri Lanka for development of affordable ROV as an import substitute which can be used for under water research and marine industry.



### **Polythene drying and pelletizing machine**

Moisture retention in half-dried waste polythene is a major problem faced during the recycling process of polythene. As pellet cannot be made from half-dried waste, it has to be dried twice using a drying machine which requires a higher amount of electricity. A machine was fabricated for complete removal of moisture from used and washed polythene and make pellets to manufacture recycled polythene. The moisture removal unit has the capacity of loading 100-150 kg of polythene and the pelletizing unit gives an output of 100-150 kg of pellets per batch. It is estimated that 1 kg of recycled polythene manufactured using imported pellets accounts for Rs 280.00 whereas same can be produced with pellets made locally fabricated machine can be made available at a price of Rs. 160.00 bringing an economic contribution to the country.

### **Non-invasive device for screening of patients**

Unprecedented increase of patients suffering from diseases such as cancer, diabetes, CKDu is an immense burden to national economy. Early identification of such diseases will enable patients to take precautionary measures and at the same time will help to cut down huge costs invested in medicines.



Non-invasive device which detects change of the endothelial function enables initial screening of such diseases. "JENDO" is a handheld, non-invasive, diagnostic medical prototype device engineered to monitor endothelial functionality in human blood vessels with the intention of predicting cardiovascular diseases. Ten prototypes were developed for measuring volumetric blood flow changes at the finger-tip and tested with patients in National Hospital, Colombo, Sri Jayewardenepura Hospital. Patent applications have been filed locally and internationally in view of commercializing the units locally and abroad. A MoU was signed between the Softlogic (Pvt) Ltd. and the grantee is to conduct further verification trials at the Asiri Hospital.

### ECG machine and patient monitor

A commercial level ECG machine was developed as an import substitute at a reduced cost compared to imported machines. Results generated from preliminary test trials with patients were promising and negotiations were in progress with the commercial partner for scaling up and industry level manufacturing of the machine.



### E-Health KIOSK

Health information systems and healthcare practices in Sri Lanka are largely relying on paper work and manual procedures that are often complicated and heavily time consuming. At present, regardless of a government or private healthcare facility, patients usually have to visit hospitals and stay long hours in queues to obtain a channel number and consult a doctor. “e-Health KIOSK” is an interactive self service system which automates routine activities of Sri Lankan healthcare sector covering patient check-in, doctor consultations through application of modern ICT. During the year 2018, Eight (8) machines were deployed at six hospitals. A unit is priced at a half of the cost of an imported machine. Accordingly, the grantee was able to contribute to the national economy by saving Rs 6.4 million foreign exchange.



### Dash board-mounted sleepiness and drowsiness detector

Number of accidents occur due to drowsiness exceed the number of accidents occur due to driving by drunken drivers. Anti Sleep Driver Alert System (ASDA) developed under the technology Grant Scheme is 90% accurate and makes drivers alert when they feel sleepy. The product uses both blinking rate of eyes and driving pattern (steering pattern) to detect drowsiness and create early warning. Device has inbuilt GPS system to detect speed and acceleration to adopt detection algorithms according to the situation. Further, the ASDA has the customized alerts system while existing products have static alert system. ASDA is similar to a size of a mobile phone and is sold at an affordable price compared to existing ones in the market and gives high level of accuracy. During the year 2018, 100 units of ASDA were sold at a competitive price and was able to contribute to the national economy by saving Rs. 2.9 million foreign exchange.

### Microbial inoculants for composting of rice straw

This project addressed a major issue in paddy cultivation; continuous application of chemical fertilizers by farmers prospecting high yields. However, the repercussions are severe as it greatly affects reduction of soil fertility causing threat to sustainable production. The project links with national requirements of introducing "grow green" technologies and contributed to promote organic agriculture minimizing agrochemical-based adverse health hazards. Microbial inoculum was developed under this project to decompose rice straw to make organic fertilizers in rice cropping systems. Paddy straw decomposing microbial inoculum packs were introduced among 600 farmer community in rice cropping areas; Polonnaruwa, Ampara, Gampola, Mahailupalama, Samanthurai etc. thus reducing chemical fertilizer usage while improving soil quality and increase yield. The product is unique in the sense for that it contains less chemicals and application would increase the crop yield.



### m-Learning- online English language learning platform

The project focuses on introducing m-learning platform for students in higher education sector in Sri Lanka. Different learning communities were identified, and their preferences were evaluated. m-learning lessons of this project were developed based on the 'English for all' curriculum targeting the identified learning communities. The lessons were developed for smart phones and standard GPRS enabled phones by considering the growing market for smart phones in Sri Lanka. Mobil4E, mobile based English learning applications (three versions- Primary, Intermediary, advanced and English learning game) for young generation/adults are available in Google Play Store. These are open and free products available for download.



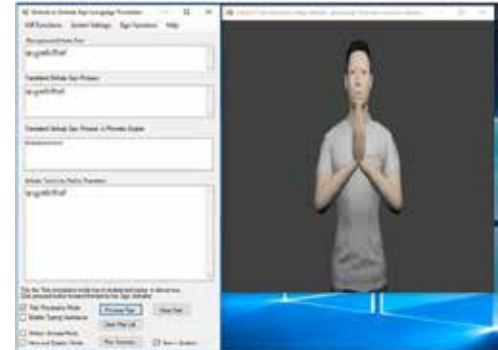
## Sinhala to sign language translation system for deaf people

Person who is born with aural disability does not have the capability to extract information from outside as the mother tongue of a deaf person is the sign language. Lack of teachers conversant in sign language to train aurally handicapped persons worsens the situation. This has resulted in the requirement for a human interpreter whenever a deaf person wants to convey a message to another healthy person or vice-versa.

To fill this void, a Sinhala to Sinhala Sign Language (SSL) translation software was developed. The framework for real time translation of spoken Sinhala language to sign language was designed in 3 stages.

1. Voice recognitions - recognize the voice of a normal person by the computer
2. Machine translation - recognized voice is translated to a sign language
3. 3D motion capture and avatar animation – sign language gestures of the translation are accurately ordered and displayed using a 3D avatar.

Discussions are in progress with national authorities to implement and deploy the system in special schools.



## Locally made screen printing machine

Local screen-printing industry (small and micro level) faces challenges such as high cost of imported machines, high running cost (mainly high energy consumption) and maintenance problems. The machine developed under the technology grant has already been commercialized and the fabrication of the second machine was in progress by the grantee on his own. Patent is pending for this invention and the inventor claims that it can be produced at an affordable cost compared to imported machines having similar output (quantity and quality) with less energy consumption.



### Interactive class room learning “Student Response System”

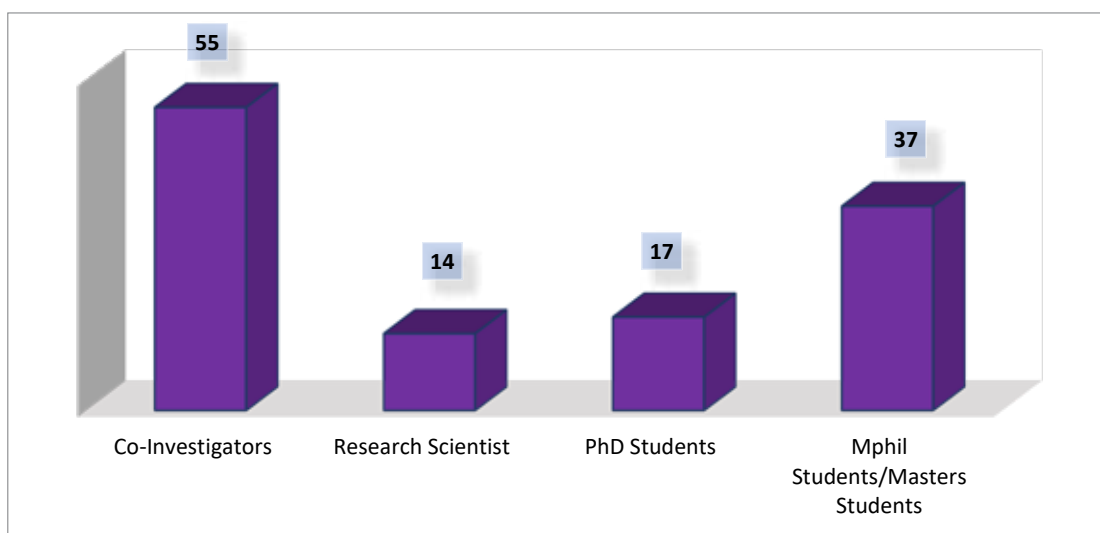
Many difficulties are faced in conducting quizzes with more than 100 students in a lecture theatre. Therefore, existing quiz mode system was upgraded to a multi-purpose response system to work in different modes; quiz mode, feedback mode and voting mode. Further, the two-way communication ability of the device is over 75 meters and it is rechargeable. The developed student response system is low cost and flexible for easy customization. During the project period 150 students hand held slave units (Clickers) with user friendly keypad and LCD display were successfully tested at University of Ruhuna.



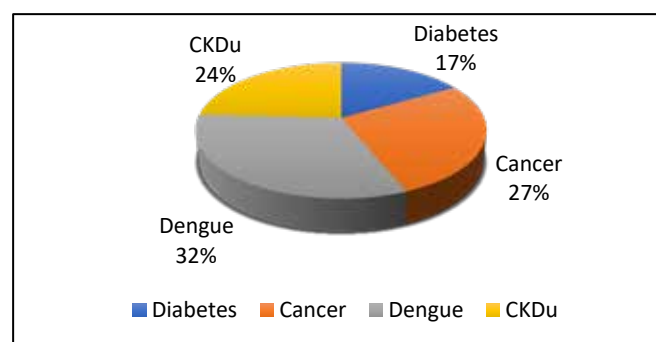
### Research Programme on Health Science (RPHS) project details and highlights

NSF launched a special Research Programme on Health Science (RPHS) in 2016 with the objective of supporting the health and allied research with national importance and to undertake co-funding to establish and maintain Research Collaborating Centers (RCCs) dedicated to specialized interests. This project was initiated with Rs. 250 Million in 2016 funded by the Government of Sri Lanka, which subsequently disbursed Rs. 100 Million and Rs. 70 Million each year until the end of 2018. RPHS was established to exclusively support research in key national health priority areas; Diabetes, Dengue, Chronic Kidney Disease of unknown aetiology (CKDu) and Cancer. A total of 22 research projects were funded by this special project and 18 of which are currently ongoing while 4 projects have been concluded.

A total of 12 research institutes and 123 Research Scientists are benefitted from this programme: 55 Co-Investigators, 14 Research Scientists, 17 PhD students and 37 MPhil/Masters Students recruited as at 30<sup>th</sup> September 2019.



Through this research programme, the NSF was able to extensively reach out to universities and research institutes across the country with funding.



Collectively, these projects are aiming to deliver the following outcomes at the end of the projects:

- To facilitate a multidisciplinary, results-oriented approach among the health science research community and to further strengthen the research infrastructure in health science in the country.
- To address health issues of national importance through a coordinated, thematic, research and development programme.
- To make recommendations on the four thematic areas of research which can be translated into both policies and action programmes for national development.
- To support the establishment of a network of high-quality research institutions linked to international Centres of Excellence that could undertake ongoing research in health science in the country.
- Establish International Collaborations.

As a summary of achievements by September 2019,

- A total of 12 research institutes and 123 Research Scientists are benefitted from this grant scheme.
- Up to now 4 PhDs, 2 MPhils and 4 MSc. Completed.
- 18 International Collaborations were established.
- Collaboration initiated with Indian Council of Medical Research (ICMR) in funding for dengue and other NCDs.
- 12 publications (including 1 publication in Nature communication), 27 abstracts, 4 newspaper articles already published.
- 1 international patent submission is in progress.
- A web based live update Cancer Patient information system in Maharagama Cancer Institute, NHSL and Kalubowila Hospital is in operation and sustaining.
- Data on the burden of CKD/CKDu in dialysis units in Sri Lanka is available online at <https://nicst.com/iframe-renal-dev/>
- Proactive Dengue Management System - Mobile Application prototype that has features to display education information, Dengue statistics and basic alerts based on location importance has been developed for implementation.

- Identification and Development of Anti-Cancer Compound Libraries - 27 plant extracts and 2 fungal extracts with anti-breast cancer activity and 12 plant extracts and 3 fungal extracts with anti-liver cancer activity identified.
- Research data bases available. Improvements are ongoing.
- Medical devises were made and available. Improvements are ongoing.
- Other output-based activities are still ongoing

### Special Project on Cinnamon

Sri Lanka has a great potential for leveraging its socio-economic development by harnessing full potential of the global cinnamon market through exportation of value-added cinnamon products, especially pharmaceuticals related Ceylon cinnamon products. However, a systematic research is yet to be carried out in associated fields such as clinical trials, chemical characterization and value chain analysis leading to value added products. Major challenges in introducing value added cinnamon products to the global market are maintaining quality consistency, traceability and repeatability.

The Ministry of Primary Industries and the National Science Foundation collaboratively implemented the Special Project on Cinnamon addressing these issues. Accordingly, 05 projects were funded under three thematic areas in order to better reach the global market. The progress of the five projects is being monitored continuously and systematically in order to obtain the envisaged deliverables.

**Table5: Fund utilization by project team**

Project site	Amount of funds released (Rs million) as at 30/09/2019
University of Peradeniya	45.4
University of J'Pura	8.2
University of Kelaniya	12.3
University of Ruhuna	7.9
Sabaragamuwa University	18.1
Total	91.9



Project highlights:

- Molecular (genetic) characterization of Sri Lankan cinnamon germplasm including wild relatives using DNA barcoding (for species level).
- Out of 525, thirty cinnamon accessions with good characteristics have been identified.
- ISSR markers and biochemical characterization of Sri Lankan Cinnamon by using coumarin (2-methoxycinnamaldehyde, 2-MCA) and other major compounds.
- Introduction of high-pressure extraction system and enzyme assist extraction to improve the quality of cinnamon extracts.
- Systematic investigation to find the effect of cinnamon extracts in controlling diabetes.
- Research on export competitiveness, value Chain characteristics, firm behavior, & policy environment is completed.
- Research on Ceylon Cinnamon value chain development, market strategies and development of model Spice market.
- Extraction and purification of potential effective components and evaluating genetic polymorphisms with the gene-lifestyle interactions of Ceylon cinnamon for neurodegenerative, neuromuscular disorders and stroke.
- Quantitative Phytochemical analysis of bark and leaf samples of Cinnamon from different maturity stages.
- Completion of physiological state analysis including flushing, flowering, seed development and ripening.
- Completion of maturity analysis using the Sri Gemunu and Sri Vijaya varieties (suitable age to harvest branches)

### 3. Highlights of other activities during 2017-2019

Table 6: Postgraduate Degrees obtained under Competitive Research Grants and Research Scholarships

Year	No. of PhD	No. of MPhil
2017	03	06
2018	04	11
2019	05	05

**Table 7: Publications and communications arising from Research Grants**

Year	No. of Publications	No. of Communications
2017	49	132
2018	32	95
2019	16	53

### **Interactive workshop on "Converting a draft manuscript to a 'Ready to Publish manuscript'"**

The Working Committee on Biotechnology of the NSF organized an interactive workshop on “Converting a draft manuscript to a ‘Ready to Publish’ manuscript” in collaboration with Research Promotion and Facilitation Centre (RPFC), Faculty of Medicine, University of Colombo from 1<sup>st</sup>-4<sup>th</sup> August, 2017.



### **Research Management Workshop**

The National Science Foundation (NSF) and the Ministry of Business, Innovation and Employment, New Zealand co-organized the Asia Pacific Regional Meeting of the Global Research Council (GRC) held in Colombo, Sri Lanka from 29th-30th November, 2017. In conjunction with this meeting, 28<sup>th</sup> November, 2017, at Hotel Galadari, Colombo with the contribution of the Resource Persons from the GRC.



## Identifying Research Gaps in Ocean & Marine Sciences

With the objective of developing a Theme Paper and Programme documents needed for the Thematic Research Programme on Ocean & Marine Sciences, the NSF Working Committee on Oceanography & Marine Resources organized a Stakeholder meeting on 24<sup>th</sup> August 2018 to meet the stakeholders and gather information to identify research gaps in Ocean & Marine Sciences. The meeting was successfully held with the participation of 50 resource persons with different expertise relevant to Ocean & Marine Sciences, representing universities, R&D institutions and the private sector.



## FAO-Ministry of Environment Bio safety Project – Special project

A special project to provide technical services to part of the FAO-Ministry of Mahaweli Development and Environment project on “Implementation of the National Biosafety Framework in accordance with the Cartagena Protocol” was initiated. 03 workshops and 03 working group meetings were organized. Introductory Workshop on Risk Assessment Guidelines for Living Modified Organisms was successfully held with 40 participants. Workshop on fundamental principles of risk analysis of GMO/FFPs was held with 28 participants.



Two-day Workshop on “Draft Guidelines for Risk Assessment of GMOs/LMOs” was held with 32 participants. Draft guidelines for contained use of GMOs, GM food & feed, GM mosquitoes, Confined Field Trials, Environmental risk assessment and Institutional Biosafety Committees were prepared and discussed.



## National Research, Development and Innovation (RD&I) Survey

NSF has been conducting a regular National Research, Development and Innovation (RD&I) Survey since 2004. This Survey measures and reports the status of science and technology sector in the country in terms of investment on Research & Development and Innovation (RD&I), engagement of Human Resources in the Science, Technology and Innovation (STI) sector, and the Outputs of the STI sector in spheres of publications, patents, technologies, innovations etc.

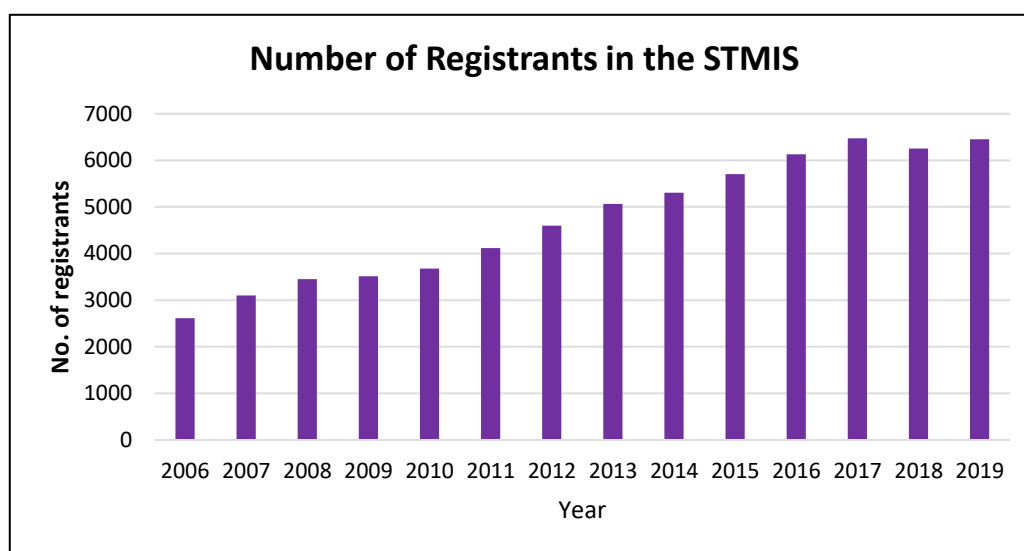
The Survey is conducted using international standards laid out by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and Organization for Economic Co-operation and Development (OECD). The scope of the Survey encompasses higher education sector, S&T institutions, R&D institutions, industrial sector and the national and international non-government organizations (NGOs). Based on the Survey for the year 2015, 'Sri Lanka Science, Technology & Innovation Statistical Handbook 2015' was published in June 2018. Data collection of (RD&I) Survey for the year 2016 was completed in December 2018 and the data collection of (RD&I) Survey 2017 which was initiated in June 2018 is ongoing.

The NSF established a strategic partnership with the Department of Census Statistics (DCS) in September 2019 to improve on the STI Statistical Handbook published annually.



## Science and Technology Management Information System (STMIS)

Science, Technology and Management Information System (STMIS) is a computerized information system developed and maintained by the NSF since 2004. The STMIS database contains information on: S&T related institutions; S&T Personnel; Technical Personnel; advanced scientific equipment available in the institutions; ongoing research activities; technologies developed and transferred by the institutions; services and training programmes offered by the S&T institutions for the general public and research publications done by the individual scientists. The STMIS database is updated regularly and the database contained information on more than more than 6400 scientists with public access for multiple use.



## Young Social Scientists Forum of the NSF

Young Social Scientists Forum of the NSF was initiated on 26<sup>th</sup> January 2018 with the participation of around 160 young Social Scientists. Main objectives of establishing this forum were to: increase the participation of young social scientists in research in relation to national development; capacity building of young social scientists; build up strong network among young and senior social scientists; create international network among social scientists; facilitate a common meeting place for young social scientists to share their experience and having public discourse on nationally important issues etc. The ultimate intention is to increase the scholarly research base and the capacity of young Social Scientists in the country.

## Launching of the publication ‘ගොවිතැනෙහි හෙළ දැනුම’

A series of data collection programmes were conducted to collect indigenous knowledge related to agriculture in four provinces of the country (Western, Uva, Sabaragamuwa and North Central). The publication, ‘ගොවිතැනෙහි හෙළ දැනුම’ was prepared based on the above information gathered through discussions with farmers who were practicing or having experience in indigenous farming. The book was launched on 13<sup>th</sup> March 2018 at the National Science Foundation with the participation of the Secretaries of the Ministry of Science, Technology and Research and Ministry of Agriculture.



## International Conference on ‘Social and Cultural Nexus of S&T Development’

International Conference on ‘Social and Cultural Nexus of S&T Development’ was held from 03<sup>rd</sup> and 04<sup>th</sup> October in Colombo with the participation of more than 100 people including foreign participants. A Policy Dialogue on “Role of Education in Promoting S&T in Sri Lanka” was a major component of the Conference.



## National Digitization Project

National Digitization Project was one of the major projects functioning as a key task of the National Science Library & Resource Centre. It was launched by the NSF in 2011 to be implemented in several phases, with the objective of digitization of local S&T literature available in research & academic institutions in the country to facilitate easy & quick online access through a national network of Institutional Repositories (IRs). Each phase comprised of three main activities, listed below.

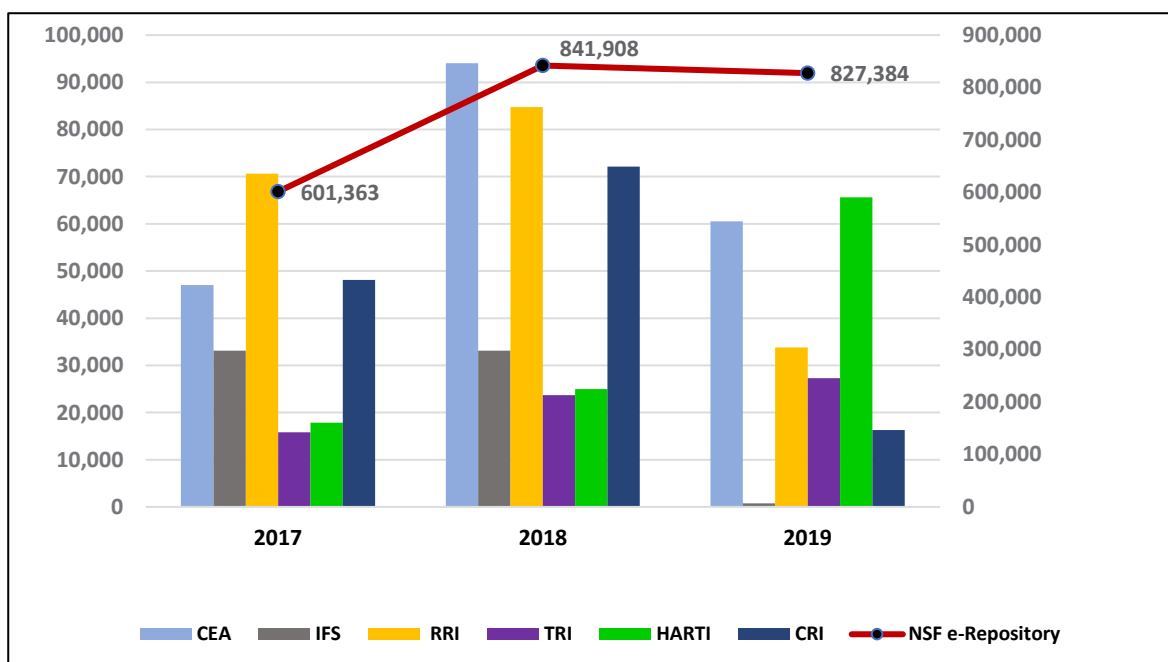
- Digitization of local literature collections in selected libraries
- Establishment of Institutional Repositories (IRs) using DSpace software for each library
- Uploading of digitized documents into IRs

In 2018, phase III of the project was progressing successfully, covering following fifteen key institutions in the country.



DSC	- Department of Census & Statistics
ID	- Irrigation Department
NSF	- National Science Foundation
CEA	- Central Environmental Authority
GSMB	- Geological Survey & Mines Bureau
ITI	- Industrial Technology Institute
MASL	- Mahaweli Authority of Sri Lanka
NL	- National Library
CARP	- Sri Lanka Council of Agricultural Research Policy
IESL	- Institution of Engineers of Sri Lanka
CRI	- Coconut Research Institute
HARTI	- Hector Kobbekaduwa Agrarian Research & Training Institute
NARA	- National Aquatic Resources Research & Development Agency
NIFS	- National Institute of Fundamental Studies
RRI	- Rubber Research Institute
TRI	- Tea Research Institute
PGIA	- Postgraduate Institute of Agriculture
PGIM	- Postgraduate Institute of Medicine
SUSL	- University of Sabaragamuwa
SEUSL	- South Eastern University of Sri Lanka
UIM	- University of Moratuwa

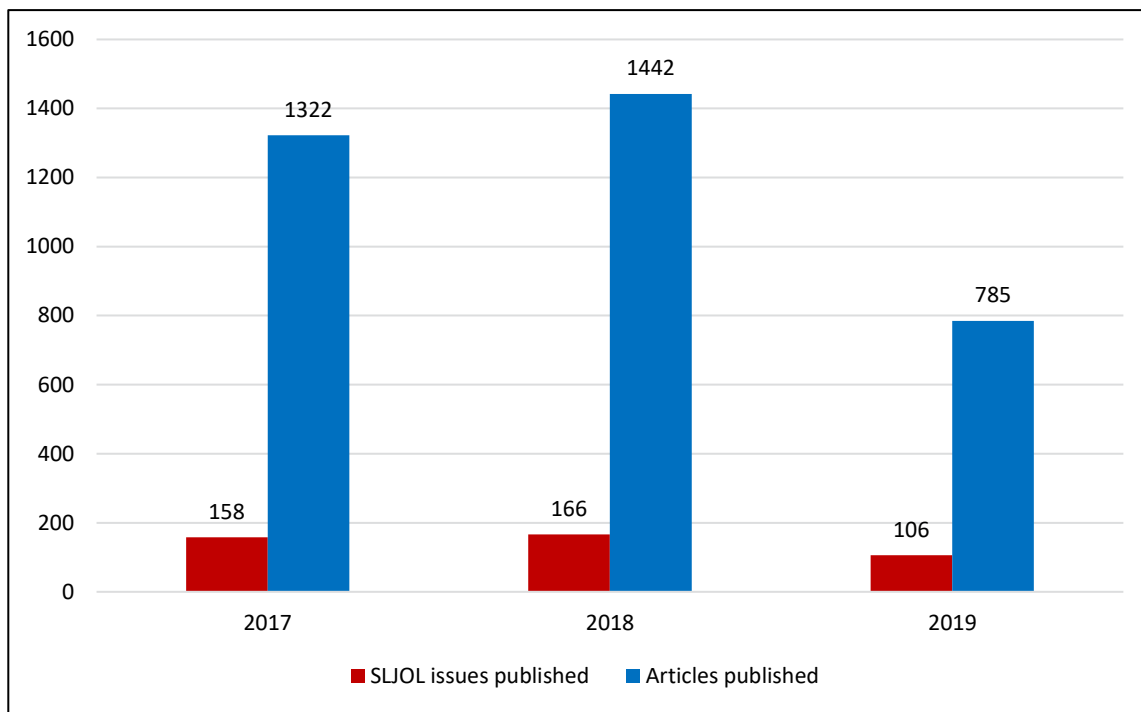
### Growth Usage of E-repositories hosted by NSF during 2017-2019



### Progress of the Sri Lanka Journals Online (SLJOL) – 2018

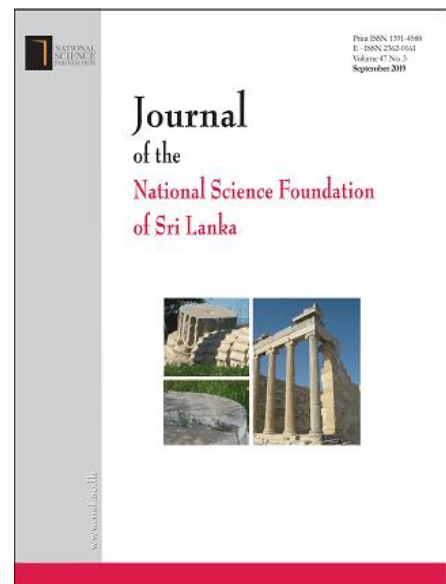
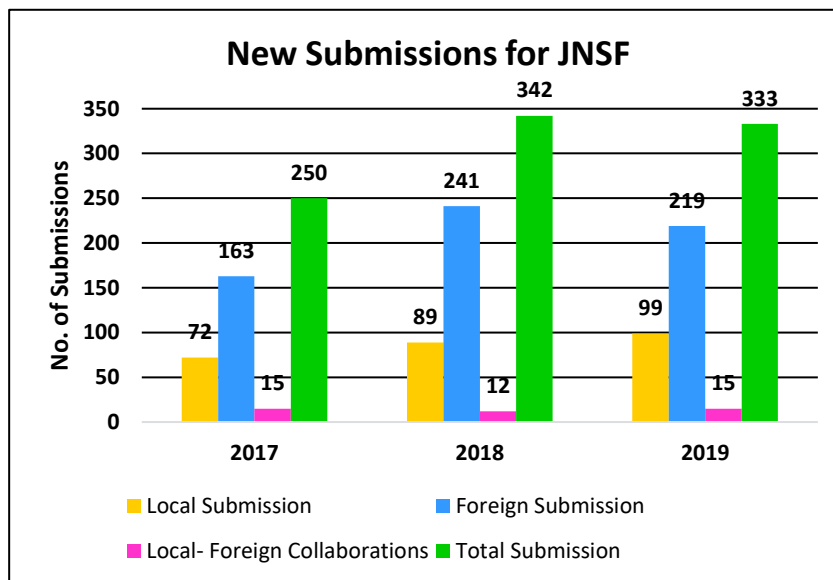
The Sri Lanka’s primary journal platform, Sri Lanka Journals Online (SLJOL) is a member of the Journals Online (JOL) project established by International Network for the Availability of Scientific Publications (INASP) of the United Kingdom. The SLJOL operated by the National Science Library & Resource Centre (NSLRC) of the NSF in collaboration with Ubiquity Press, UK shares the local knowledge of the full range of academic disciplines from North to South and East to West by overcoming the great challenge faced by Sri Lankan researchers in disseminating their findings worldwide.





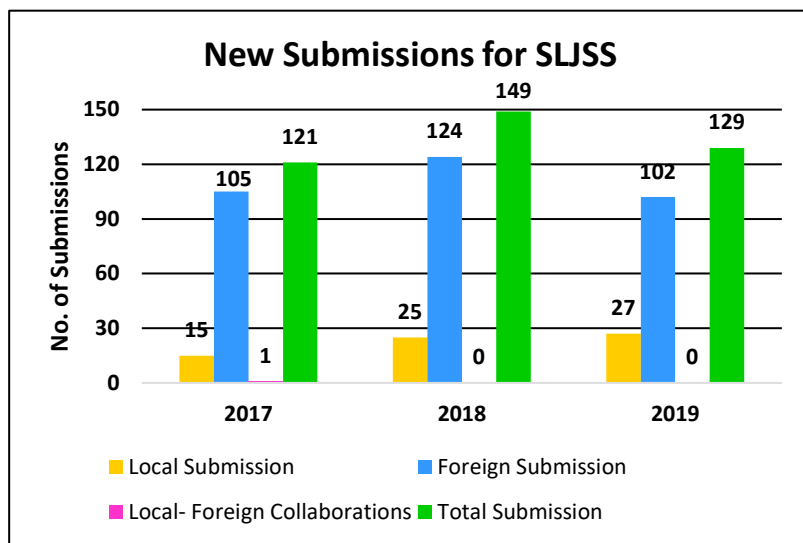
**Growth of the SLJOL**

### Journal of the National Science Foundation (JNSF)



As of 2018, the JNSF has an Impact Factor of 0.419 in the Science Citation Index Expanded (SCIE) of Clarivate Analytics (former Thompson Reuters).

## Sri Lanka Journal of Social Sciences (SLJSS)



SLJSS was indexed in Elsevier SCOPUS in August 2017. It was also in the ESCI (Emerging Sources Citation Index) of Clarivate Analytics (former Thompson Reuters) in July 2018, becoming one of the five Sri Lankan academic journals indexed in the ESCI.

### Research collaborations with International bodies

#### German Research Foundation (GRF)

A Meeting on the future scientific cooperation between the German Research Foundation (GRF) and the National Science Foundation of Sri Lanka was held on 23rd January 2017 in Colombo at the National Science Foundation. This meeting was followed by visits of the GRF delegates to some research institutes of Sri Lanka such as Sri Lanka Institute of Nanotechnology (SLINTEC) and the National Institute of Fundamental Studies (NIFS).

#### Establishing the partnership with ICSSR

The NSF established a partnership with the Indian Council of Social Science Research (ICSSR) by signing a MoU in October to accomplish the exchange of scholars between the two countries, training young social scientists & enhancing collaborative research and organizing joint conferences.

A report with recommendations on "Intellectual Property Rights Protection of Indigenous Knowledge" was published.

## **National Natural Science Foundation, China (NSFC)**

The 1st Joint Workshop was organized by the NSF and the NSFC from 4th to 7th July, 2017 in Beijing, China on the themes; CKDu & Health Science and Water & Environmental Sciences.

This was the first implementational step under the Memorandum of Understanding (MoU) between NSF and the NSFC signed in 2016.

The first Joint call for research project proposals under this MoU in the areas of Health Sciences and Water & Environmental Sciences was opened from 29th September, 2017 to 12th January, 2018.



## **Memorandum of Cooperation with the Japan Science and Technology Agency (JST)**

A Memorandum of Cooperation (MoC) on Bilateral Scientific Cooperation was signed with the Japan Science and Technology Agency (JST) on 02nd October, 2017 during the Annual event of 'STS Forum – Japan'. Prof. Sirimali Fernando, Chairperson/ NSF and Prof. Michinari Hamaguchi, President/JST were the signatories from both parties.



## Meeting with the Global Research Council (GRC)

National Science Foundation, Sri Lanka (NSF) along with the New Zealand Ministry of Business, Innovation and Employment co-organized the Asia Pacific Regional Meeting of the Global Research Council (GRC) on 29th and 30th November, 2017 in Colombo. Forty-one (41) participants from nineteen (19) countries including Sri Lanka participated at this meeting. The two themes; 'Peer Review' and 'Science Diplomacy' were discussed extensively at the meeting. The participants came up with some common recommendations on both themes which are to be considered at the next Annual Meeting of the GRC in 2018 in Moscow, Russia, in order to come up with joint statements of principals to be practiced by the granting agencies.



## German Academic Exchange Service (DAAD)

The first Joint call for proposals on Project based Personnel exchange Programmes (PPPs) was held between the NSF and DAAD from 14<sup>th</sup> June to 30<sup>th</sup> August, 2018. Awareness sessions on this programme were held at the NSF and the Universities of Moratuwa, Peradeniya and Colombo on from 03<sup>rd</sup> to 05<sup>th</sup> July, 2018 with the participation of the officials from DAAD and NSF. Screening of the project proposals received under this call were evaluated for selection for joint funding.

## International Science Council – Stakeholder meeting on urban studies

A stakeholder meeting was conducted on 02<sup>nd</sup> April 2019 in the NSF with the participation of key stakeholders involved in urban development, planning, health and wellbeing to identify research gaps and to come up with recommendations to uplift sustainable urban development in the country.



## First meeting of Sakura Science Club Alumni Association Sri Lanka (SSCAASL)

First meeting of Sakura Science Club Alumni Association Sri Lanka (SSCAASL) was held successfully on 21<sup>st</sup> February 2019 in collaboration with the Japan Science and Technology Agency (JST). Officials of JST, diplomats from the Japanese Embassy in Colombo, academics, young researchers and school children participated at the meeting. The meeting aimed at strengthening ties and networks among young researchers in Sri Lanka and consolidate resources/knowledge to enhance STI capability in Sri Lanka.



## **An Awareness Programme on the NSF-DAAD Project based Personnel Exchange Programme (PPP)**

An Awareness Programme on the NSF-DAAD Project based Personnel Exchange Programme (PPP) was held on August 16 in the NSF with the participation of scientists, researchers, technologists and students. This was jointly organized by the NSF and the German Academic Exchange Service (DAAD) etc.



## **Meeting with the Vice President of the National Natural Science Foundation, China (NSFC)**

A meeting was held on 10<sup>th</sup> September 2019 between the officials of NSF and a delegation from China led by Prof. Fu Gao, Vice President of the National Natural Science Foundation, China (NSFC). Way forward regarding the collaborations between NSF and NSFC were discussed at this meeting.



## **International Center for Genetic Engineering and Biotechnology – Regional Research Center (ICGEB-RRC)**

The ICGEB has indicated their willingness to provide technical support for establishing an ICGEB Regional Research Centre (RRC) in Sri Lanka. Establishment of such a Center from the scratch with its own infrastructure including buildings will take a long time and significant capital investment. As an interim measure, it was proposed to upgrade a suitable existing institution conducting research in biotechnology in Sri Lanka as the RRC. The NSF is in the process of evaluating selected institutions, identifying functions and making recommendations.

## Meeting on Bilateral Scientific Cooperation with the German Ambassador

A meeting was held with H.E. Jörn Rohde, the German Ambassador on the possibilities of bilateral scientific cooperation with Germany on September 23 at the NSF. The meeting was led by Dr A.M. Mubarak, Chairman of the NSF. Mr P. Selvaraj, Additional Secretary (Bilateral Affairs) of the Ministry of Foreign Affairs also attended this meeting.



## Meeting on Bilateral Scientific Cooperation with South Africa

A meeting was held with H.E. Robina P. Marks, the South African High Commissioner on the possibilities of bilateral scientific cooperation with South Africa on 07<sup>th</sup> October at the NSF. The meeting was led by Dr A.M. Mubarak, Chairman of the NSF. Mr P. Selvaraj, Additional Secretary (Bilateral Affairs) of the Ministry of Foreign Affairs also attended the meeting.



## Knowledge Sharing Programmes (KSP)

### Safer Communities with Hydro-Meteorological Disaster Resilient Houses

NSF organized a KSP to disseminate the findings of the above research project. The programme was held on 30<sup>th</sup> January at the NSF with the participation of senior academics of universities and senior officials from several government institutions. Profs. Chintha Jayasinghe & M. T. R. Jayasinghe were the resource persons in the field of Civil Engineering, University of Moratuwa.



## Artificial Intelligence

The NSF provided a training scholarship to Ms Chapa Sirithunga, a graduate student from Dept of Electrical Engineering, University of Moratuwa to follow the 19<sup>th</sup> advanced course on artificial intelligence at Chania Crete, Greece. A KSP on this was held at NSF 24<sup>th</sup> September 2019 to share knowledge.



## Inculcating a research culture amongst the school children

### Sri Lanka Science and Engineering Fair (SLSEF)

Sri Lanka Science & Engineering Fair (SLSEF) 2018 was conducted on 19 February 2018 at the Institutions of Engineers Sri Lanka (IESL) with the 10 best science projects selected from the SRPC 2017 and the best ten inventions selected from the Junior Inventor of the Year 2017 organized by IESL. The winners (listed below) out of 20 competitors were felicitated at the NSF School Science Day Programme.

1. K R R Induwara – Ananda National School, Chilaw
2. L S Sasipriya Silva - De Mezenode College, Kadana
3. K M G Kavinda Bandara - St` Anthony`s College, Kandy
4. K G Wijayawardana - St` Anthony`s College, Kandy



### Intel International Science and Engineering Fair (Intel ISEF)

The winners of the SLSEF 2017 (three national winning projects under SLSEF - 2017) participated at the Intel International Science & Engineering Fair (Intel ISEF) 2017, held in Pittsburgh, Pennsylvania, USA from 13 - 18 May, 2017. The group project titled "Micro and Nano engineering for wastewater: magnetized biochar and nanoparticle composite for toxic Cr (VI) removal" presented by the two students, Shehan Kavishka and Sankalpa Perera of S. De S. Jayasinghe Maha Vidyalaya, Dehiwala, trained under the SRPC 2016 was presented with the Grand Award (fourth place with a cash prize of USD 500/=) under the category, "Earth and Environmental Sciences" at the Intel ISEF 2017. This was the first time a Grand Award was won at the Intel ISEF for a science project monitored under the SRPC. The two students also won a Special Award (Mawhiba's Special Award) with a cash prize of 1,000 USD at the Special Award Ceremony of the Intel ISEF 2017. The two students represented JIY at the Intel ISEF 2017 were, G K N Wishvajith Gangodawila of Mayurapada Central College, Narammala, and W S Udantha Abeyawickrama at Darmasoka College, Ambalangoda.





The Intel international Science & Engineering Fair (Intel ISEF) 2018 held at Pittsburgh, Pennsylvania, United States from 13<sup>th</sup> – 19<sup>th</sup> May 2018 was represented by Master K R R Induwara of Ananda National School, Chilaw as the national winner of the SLSEF 2018 and won the third place under the category, Microbiology. He was felicitated at the Grand Award Ceremony of the Intel ISEF 2018 for his winning project titled "Isolation of a potential microbial agent for controlling dengue vector mosquitoes in Sri Lanka" which was carried out under the SRPC 2017. Kavindra Wijayawardana & Gajindu Bandara, of St. Anthony's College, Katugasthota and L S Sasipriya Silva of De Mezenode College, Kadana, the winning competitors of JIY, were the other two participated at the Intel ISEF 2018.



ISEF 2019 was held from 12<sup>th</sup> – 17<sup>th</sup> May 2019 in Phoenix, Arizona, USA. Two students and one group of students took part in the event. The student, W. A. K. B. Udapola from Sandalankawa, Central College, Sandalankawa won the grand award for the invention titled “Safe gas regulator”.



The group of students were R.S.R. Senavirathna, H. L. C. D. Hashela, S.S.R. De Silva from Gnanodaya Maha Vidyalaya, Kalutara with the project Titled “Effect of acidity on seed germination of selected varieties of paddy” and the third participant was M.Z.M. Ayyash from Zahira College, Mawanella with the invention “Safe branch cutting device”.



## Annual Report 2017

The NSF is the winner of the competition “Best Annual Reports and Accounts Awards for Public Sector – 2017 under the category “Research Institutions”. The Association of Public Finance Accountants of Sri Lanka (APFASL), the Public Sector Wing of CA Sri Lanka holds this competition annually. The Annual report 2017 of the NSF contains an analysis of all the work performed during the year with 47 graphical presentations, 12 tables, 79 pictures and 23 annexures that would enable the interested parties to form a judgment on performance of the NSF, future prospects and constraints of the institute. Dr Thamara F. Dias/ Additional Director of the NSF and the Director General (Covering) in 2017 received the award from Mr Udaya Seneviratne/Secretary to the President who was the Chief Guest of the event on October 25<sup>th</sup>, 2019.



