SCIENCE AND TECHNOLOGY
STATUS REPORT OF SRI LANKA - 2017

National Science and Technology Commission
Ministry of Science, Technology & Research

SCIENCE AND TECHNOLOGY STATUS REPORT OF SRI LANKA - 2017

(Based on data collected from 33 Public Sector S&T Institutions)

National Science and Technology Commission

Ministry of Science, Technology and Research

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National Science and Technology Commission (NASTEC)

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FOREWORD

Science & Technology (S&T) sector plays an important role in socio economic development in the country during this era of rapid global technological advancements. In order to move up from the lower-middle income status, Sri Lanka can no longer remain stagnant as a traditional, but to move forward with the world as it approaches the era of fourth industrial revolution. Science, Technology and Innovation is the key in achieving this target. Sri Lanka will need improved S&T capacity if we are to capitalize on opportunities for economic growth. In order to achieve this, it is essential to first assess the current S&T capacity of the country. The National Science and Technology Commission (NASTEC) being the apex policy formulating and advisory body on S&T matters to the government of Sri Lanka is mandated to review the S&T status in the island. The S&T data collected under this activity from state S&T institutions will be a vast knowledge source in measuring the current S&T capacity of the country. Therefore, this S&T Status Report of Sri Lanka compiled by NASTEC will be helpful to identify deficits and gaps in S&T capacity. These identifications can be used for improvements by the adoption of appropriate policies and activities in areas under human resource & infrastructure development, investment in R&D, public support of S&T, access to information and communication technologies (ICT), information dissemination, etc.

The recommendations given at the end of this report act as implementation actions that can be carried out by relevant stakeholders, which include the Government of Sri Lanka, relevant ministries, S&T institutes, private sector industries, and public.

I would like to thank NASTEC for their hard work towards successful completion of the S&T Status Report for the year 2017 and would like to extend the gratitude to the Chairpersons, Directors and CEOs of the state S&T institutions who provided requested data for the report.

Prof. W.L. Sumathipala
Chairperson,
NASTEC

PREFACE

The National Science and Technology Commission (NASTEC) was established by the Science and Technology Development Act No. 11 of 1994 and came into operations in August 1998. It was formally inaugurated on 06th December 1998 and became a functional commission in January 1999. NASTEC was designed to be the apex policy formulating and advisory body on science and technology matters to the Government of Sri Lanka. One of the mandated functions of NASTEC is to submit a report annually to the government, reviewing the science and technology activities in Sri Lanka in the preceding year under the effectiveness of different measures; human resources, the performance of science and technology institutions, the effectiveness of public spending on science and technology, and the use of science and technology by public sector and private sector undertakings. To fulfil these objectives, the NASTEC has reviewed the status of 33 public sector Science and Technology institutions during the year 2017.

Information was collected on five broad areas: i) Human Resources, ii) Physical Resources, iii) Research Inputs, iv) Research Outputs, and v) Services Provided by S&T Institutes. The data collected from individual S&T institutions was analyzed to compile a report that reviews their contribution towards the overall S&T status of the country within the year of review. This report will be beneficial in assessing the S&T status of the country in the year 2017 and make a comparison of progress made in science and technology compared to preceding years.

I am very thankful to the Chairpersons/Director Generals/Directors of the institutions who responded to the survey by contributing the institutional data, which enabled to prepare this national S&T report. I would also like to thank the Director and staff of NASTEC for the valuable service rendered towards preparing this document.

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ACRONYMS

ACCIMT – Arthur C Clarke Institute of Modern Technology

BMARI – Bandaranayake Memorial Ayurvedic Research Institute

CEA – Central Environmental Authority

CPD – Continuing Professional Development

DOM – Department of Meteorology

DEA – Department of Export Agriculture

FD – Forest Department

FMRC – Farm Mechanization Research Centre

FORD – Fields of Research and Development

FRDI – Fruit Research Development Institute

GDP – Gross Domestic Product

GERD – Gross Domestic Expenditure on R&D

GJRTI – Gem and Jewellery Research and Training Institute

HARTI – Hector Kobbekaduwa Agrarian Research and Training Institute

HORDI – Horticultural Crop Research and Development Institute

HRD – Human Resource Development

HRST – Human Resources in Science & Technology

ICT – Information Communication Technology

IPHT – Institute of Post Harvest Technology

IPR – Intellectual Property Rights

ISCED – International Standard Classification of Education

IT – Information Technology

ITI – Industrial Technology Institute

LKR – Sri Lankan Rupees

MRI – Medical Research Institute

NASTEC – National Science and Technology Commission

NBRO – National Building Research Organization

NERDC – National Engineering Research and Development Centre

NIFS – National Institute of Fundamental Studies

NPQS – National Plant Quarantine Service

NRC – National Research Council

NRDF – National Research and Development Framework

NRMC – Natural Resources Management Centre

NSF – National Science Foundation

OECD – Organization for Economic Co-operation and Development

PGRC – Plant Genetic Resource Centre

PPP – Public Private Partnerships

PPS – Plant Protection Service

R&D – Research & Development

RPO – Office of the Registrar of Pesticides

RRDI – Rice Research and Development Institute

RRI – Rubber Research Institute

S&T – Science & Technology

SCI – Science Citation Index

SCPPC – Seed Certification and Plant Protection Centre

SCS – Seed Certification Services

SDGs – Sustainable Development Goals

SLAB – Sri Lanka Accreditation Board for Conformity Assessment

SLCARP – Sri Lanka Council for Agricultural Research Policy

SRI – Sugarcane Research Institute

TOT – Transfer of Technology

TRI – Tea Research Institute

UIS – UNESCO Institute of Statistics

UNESCO – United Nations Educational, Scientific and Cultural Organization

VRI – Veterinary Research Institute

EXECUTIVE SUMMARY

The National Science and Technology Status Report of 2017 is compiled with S&T data collected from 33 state-sector Science & Technology institutions of Sri Lanka. These institutions were categorized into five sectors based on Organization for Economic Co-operation and Development (OECD) Fields of Research & Development (FORD) (OECD, 2015)[1], for reporting purposes. The five sectors are; i) Natural Sciences, ii) Engineering and Technology, iii) Medical and Health Sciences, iv) Agricultural and Veterinary Sciences and v) Other. The first four sectors include S&T institutes that carry out their functions under related R&D fields (Annexure 01), and the 'Other' sector includes institutes that provide funding for research and institutes that carry out standardization & accreditation functions. Data gathered from the questionnaire survey is presented in the report under four major sections; Human Resources, Physical Resources, Finances, and Productivity. Section 'Productivity' includes research outputs and services provided by institutions. These S&T institutions function under six ministries. A majority of 16 institutes is under the Ministry of Agriculture, Rural Economic Affairs, Livestock Development, Irrigation and Fisheries, and Aquatic Resources Development. The Ministry of Science, Technology and Research has seven institutes under it.

In the year of 2017, a total number of 6,870 staff (permanent = 6,682; on contract basis = 188) was working in 33 S&T institutes and 3,289 of them were scientific staff (Research staff = 923; Research support staff = 2,339; Librarians/Information officers = 27) and 3,581 were non-scientific staff. From the research staff, 53% were females (n=487) and 47% were males (n=436). The highest number of research staff was in Agricultural & Veterinary sector (n = 400), followed by Engineering & Technology (n = 295), Natural Sciences (n = 133), 'Other' (n = 51), and Medical & Health (n = 44) sectors respectively. The number of research staff in the institutions ranged from 3 (PPS, SCPPC) to 128 (NBRO) and the average number of research staff per institute was 28.

Majority of research staff showed expertise in fields of Agricultural & Veterinary Sciences (38.6%) and Natural Sciences (34.2%), followed by Engineering & Technology (16.7%), Social Sciences (6.7%), and Medical & Health Sciences (3.8%). The highest qualifications of

[1]OECD (2015), *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.
DOI: http://dx.doi.org/10.1787/9789264239012-en

research staff in 2017 included PhD (n = 144), MPhil (n = 65), MSc/MA (n = 332), BSc (n = 352) and Diploma (n = 30). The highest number of research staff was found in the age group of 41-50 years (n = 293), followed by 31-40 years (n = 269),>51 years (n = 206) and <30 years (n = 155). During the said year, 201 scientific staff were recruited by the institutions and 147 scientific staff left the institutions. Altogether 48 postgraduate degrees (PhD = 17, MPhil = 12, MSc/MA = 14, Postgraduate Diploma = 5) were funded by the institutions for the scientific staff within the institutes. A total of 2,873 scientific staff members participated in 601 workshops, seminars, conferences and training programs that included 269 local and 332 international programs.

From the 33 institutes surveyed, 13 institutions (39%) referred the National S&T Policy and 18 institutions (55%) referred the National Research & Development Framework (NRDF) as a source document for the preparation of institutes' action plans. Majority of institutions that identified / implemented NRDF based activities prioritized in the following areas: Environment (n = 18), Food, Nutrition & Agriculture (n = 15) and Water (n = 11). The highest number of projects carried out by institutes related to Sustainable Development Goals (SDGs) belong to SDGs: Good health and well-being (n = 37), Zero hunger (n = 27) and Industry, innovation and infrastructure (n = 27).

In 2017, the institutes received LKR 1,821.01 million as funds for research projects. Out of the total amount received, LKR 1,700.54 million (93.4%) had been utilized. The Treasury was the main funding source for research-based activities. Agricultural & Veterinary Sciences sector received the highest amount of funds for research projects (LKR 1,233.65 million). During the said year, LKR 164.55 million funds were received for science popularization, workshops, seminars and LKR 665.06 million funds were received for upgrading S&T institutes.

Reviewed S&T institutes carried out 879 research projects out of which 295 were completed and 584 were ongoing at the time of data collection. A total of 52 new products, 35 processes, and 51 technologies were developed through research during the year 2017. A total of 1,301 publications had been published by S&T institutions, where majority being abstracts (n = 676). A total of 17 items received patents filed by institutes, all 17 being national patents. Out of these, four patents were implemented and another patent was sold. A total of 51 awards received by scientific staff / institutions comprised 44 national awards and 7 international awards. The number of commercialized products and processes was 47 and 25 respectively.

These institutes transferred 48 technologies, and 36 recommendations were adopted. In the year 2017, S&T institutions reported a generation of LKR 909 million through client-based services including; testing, calibration, training, product and process certification, accreditation services and consultancies. A total of 504,461 clients were served through these services during the year under review.

1. INTRODUCTION

The National Science and Technology Commission (NASTEC) was established by the Science and Technology Development Act No. 11 of 1994 and came into operations in August 1998. NASTEC is the designated apex policy formulating and advisory body on science and technology matters to the Government of Sri Lanka. NASTEC is mandated to submit a report annually to the government, reviewing the Science and Technology (S&T) activities in Sri Lanka in the preceding year. The report comprises a compilation of collected data which related to human and physical resources of S&T institutions, effectiveness of public spending on S&T, and performance of S&T institutions. Data collection was through a self-administered questionnaire collected from 33 public sector institutes on relevant S&T information basis the year 2017.This data is classified under human resources, physical resources, research planning, research inputs (funding), research outputs, and services (for industries, S&T institutions, public).

Each institute appointed a liaison officers appointed by each institute to assist with data collection and questionnaire completion. The collected data were analyzed and compiled into a report, which provides a detailed analysis of the public sector contribution to the S&T activities in Sri Lanka in 2017. The findings and conclusions derived from this survey as well as the recommendations given will be beneficial for future planning and investment on projects related to S&T matters in Sri Lanka.

Scientific and technological innovations enable the country to improve competitiveness and productivity, giving the means to achieve a higher standard of living and a better quality of life. They offer solutions to many of the important global and national issues; providing the knowledge and the means to generate economic activity, to improve health and living standards, to alleviate poverty, to enhance public safety and security, to preserve the quality of the environment, and manage country's natural resources. With increasingly competitive global economy, science and technology clearly is an important strategic driver to achieve balanced national development. It is therefore imperative that a strong commitment is made to harness the potential of science and technology as a key driver in raising the national capacity to acquire and utilize knowledge, to foster innovations and simultaneously ensure economic development and human welfare.

For the analysis, the 33 S&T institutions surveyed were divided in to five categories based on OECD Fields of Research & Development (OECD, 2015) (Table 1.1). The institutions which

could not be directly included under the major R&D sectors were categorized under the 'Other' category which includes institutes which provide funding for research activities and institutes that carry out standardization and accreditation functions. The number of institutions included in each sector are given in Table 1.1.

Table 1.1: Sector-wise distribution of S&T institutes

Sector	Number of Institutes	%
Natural Sciences	5	15
Engineering & Technology	5	15
Medical & Health Sciences	2	6
Agricultural & Veterinary Sciences	18	55
Other	3	9
Total	33	100

From the 33 institutes, highest number of institutions was included in Agricultural & Veterinary Sciences sector (n = 18). The list of institutions belonging to each sector is given in Table 1.2.

Table 1.2: Sector-wise categorization of public sector S&T institutions in Sri Lanka

Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other
Central Environmental Authority (CEA)	Arthur C. Clarke Institute for Modern Technologies (ACCIMT)	Bandaranaike Memorial Ayurvedic Research Institute (BMARI)	Department of Export Agriculture (EAD)	National Research Council (NRC)
Department of Meteorology (DOM)	Farm Mechanization Research Centre (FMRC)	Medical Research Institute (MRI)	Forest Department (FD)	National Science Foundation (NSF)
Gem & Jewellery Research and Training Institute (GJRTI)	Industrial Technology Institute (ITI)		Fruit Research and Development Institute (FRDI)	Sri Lanka Accreditation Board for Conformity Assessment (SLAB)
National Institute of Fundamental studies (NIFS)	National Building Research Organization (NBRO)		Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI)	
Natural Resources Management Centre (NRMC)	National Engineering Research & Development Centre (NERDC)		Horticultural Crop Research & Development Institute (HORDI)	
			Institute of Post Harvest Technology (IPHT)	
			National Plant Quarantine Services (NPQS)	
			Plant Genetic Resource Centre (PGRC)	
			Plant Protection Service (PPS)	
			Registrar of Pesticide Office (RPO)	
			Rice Research & Development Institute (RRDI)	
			Rubber Research Institute (RRI)	
			Seed Certification & Plant Protection Centre (SCPPC)	
			Seed Certification Services (SCS)	
			Sri Lanka Council for Agricultural Research Policy (SLCARP)	
			Sugarcane Research Institute (SRI)	
			Tea Research Institute (TRI)	
			Veterinary Research Institute (VRI)	

The statutory functions related to S & T can be categorized in to six main sections.

1. Research & Development (R&D)
2. Research Funding
3. S&T Services
4. S&T Policy Formulation
5. Technology Transfer
6. Science Popularization

Number of institutions that carry out each of these functions is indicated in Table 1.3, and sector-wise distribution of S&T institutions that carry out statutory functions are given Figure 1.1.

Table 1.3: Major statutory functions conducted by S & T institutions

Statutory Function	Number of Institutions	%
R&D	28	85
Research Funding	5	15
S&T Services	22	67
S&T Policy Formulation	8	24
Technology Transfer	21	64
Science Popularization	12	36

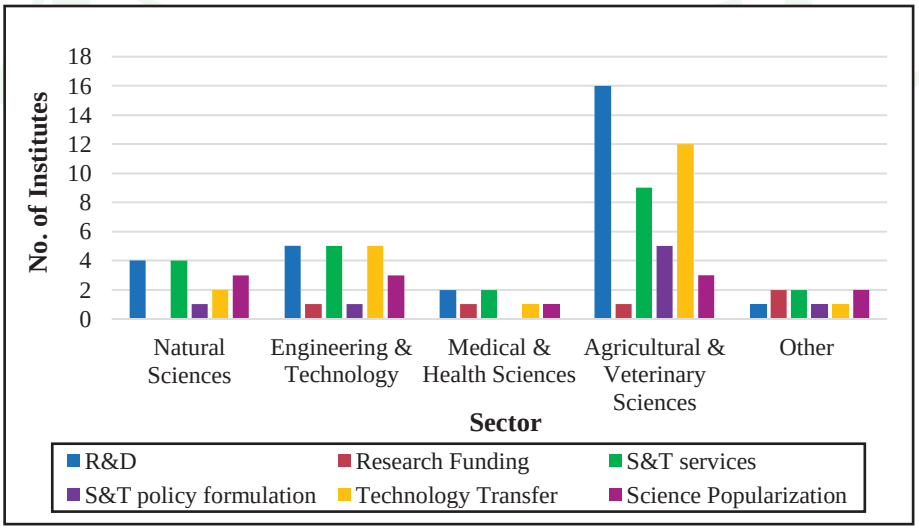


Figure 1.1: Sector-wise distribution of statutory functions

Research & Development (R&D) refers to innovative activities undertaken by the institution in developing new services or products, or improving existing services or products. Research and development constitutes the first stage of development of a potential new service or production process. Majority of institutions (85%) carried out R&D as one of the main statutory functions.

Research funding includes providing funds for R&D activities that consists of basic research, applied research and experimental development. According to the survey, five institutes provided research funding, namely; NRC, NSF, SLCARP, MRI and NERDC.

S&T services consist of produce testing, analyzed, services quality assurance, laboratory accreditation, instrument calibration or any other specialized services provided by institutions. Out of the 33 institutes surveyed, 22 institutes (67%) carried out at least one of these S&T services mentioned.

Science and technology policy covers the public sector measures designed for the creation, funding, support, and mobilization of scientific and technological resources. S&T policies cover a very broad range of knowledge producing activities. These include public as well as private sector activities, research and productive activities (Arvanitis, 2009)[2]. Eight institutes (24%) involved in S&T policy formulation activities.

Technology transfer is the process of transferring (disseminating) technology from the places of its origin to a wider audience among more people and places. It often occurs by concerted efforts to share skills, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities at governments / universities / other institutions to ensure that scientific and technological developments are accessible to a wide range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services. Twenty one (64%) of surveyed institutes participated in technology transfer.

Science popularization implies; bringing science to the public, to disseminate scientific knowledge, and to foster a scientific way of thinking among people[3]. In particular, science popularization refers to public understanding of science and public communication of research projects. Twelve institutes (36%) took part in such activities during the focused year.

[2]Arvanitis, R. (Ed.). (2009). *Science and Technology Policy– Volume I*. Oxford, UK: EOLSS
[3]Publications https://www.discog.unipd.it/science-popularization

2. HUMAN RESOURCES

Human Resources in Science and Technology (HRST) refer to people who have successfully completed education at the tertiary level in S&T field and/or those who are not formally qualified in this way but employed in a S&T occupation where such qualifications are normally required(OECD, 1995)[4].The global demand for HRST is increasing as countries worldwide move towards knowledge-based economies. For this purpose, knowledge driven countries need to build a critical mass of well-trained professionals that can be classified in to categories 5 (technician-level qualifications), 6 and 7 (university-level qualifications) of The International Standard Classification of Education (ISCED), which is a classification based on levels of education and fields of study. ISCED distinguishes twenty-one main fields of study that can be categorized in to seven broad fields of study in S&T, which includes Natural Sciences, Engineering and Technology, Medical Sciences, Agricultural Sciences, Social Sciences, Humanities, and Other fields (OECD, 1995).

In this report, the number of scientific & non-scientific staff, categories of scientific staff employed in S&T institutions, the fields of study of the research staff, their highest level of education, age and gender compositions, staff turnover for the year, staff training provided and incentives given are discussed.

2.1 Categories of staff employed in S&T institutions

The human resources employed in S&T institutions are categorized as Scientific, Accounting, Administrative, and Other staff. The scientific staff is further categorized in to Research Staff, Research Support/Technical Staff, and Librarians/Information Officers.

Definitions:

Scientific staff: Includes only Research Staff, Research Support Staff, and Librarians & Information officers.

Research staff: Staff who possess relevant qualifications and who are responsible for the conception or creation of new knowledge, product, processes, methods and systems, and management of the project concerned.

[4]OECD (1995), Canberra Manual 1995: The Measurement of Scientific and Technological Activities, Manual of the Measurement of Human Resources Devoted to S&T, OECD Publishing, Paris.

Research support staff: Employees with an appropriate technical qualification or diploma who support the functioning of S&T activities in the institution, but are not involved with planning and implementation of such activities.

E.g.: Computer unit, Workshop, Maintenance, etc.

Librarians: Librarians are considered as Informative Scientists who belong to the scientific staff.

Administrative staff: All persons employed in the administration duties of the institution and not directly involved with any science or research related activity.

Accounting staff: All persons employed in the finance & accounting duties of the institution and not directly involved with any science or research related activity.

Supporting staff non-research: secretarial, skilled/unskilled craftsman, gardeners, animal housekeeper etc. who directly associate with or provide services to the researcher.

The total number of employees working in the 33 S&T institutes was 6,870, out of which 6,682 (97%) were permanent staff and 188 (3%) were staff on contract basis for more than 6 months in the year 2017. The lowest number of staff members (n = 14) was reported by NRC while the highest number of 974 were working in CEA. Out of the total, 3,289 (47.9%) were scientific staff and 3,581 (52.1%) were non-scientific staff. The sector-wise distribution of scientific & non-scientific staff is shown in Figure 2.1.

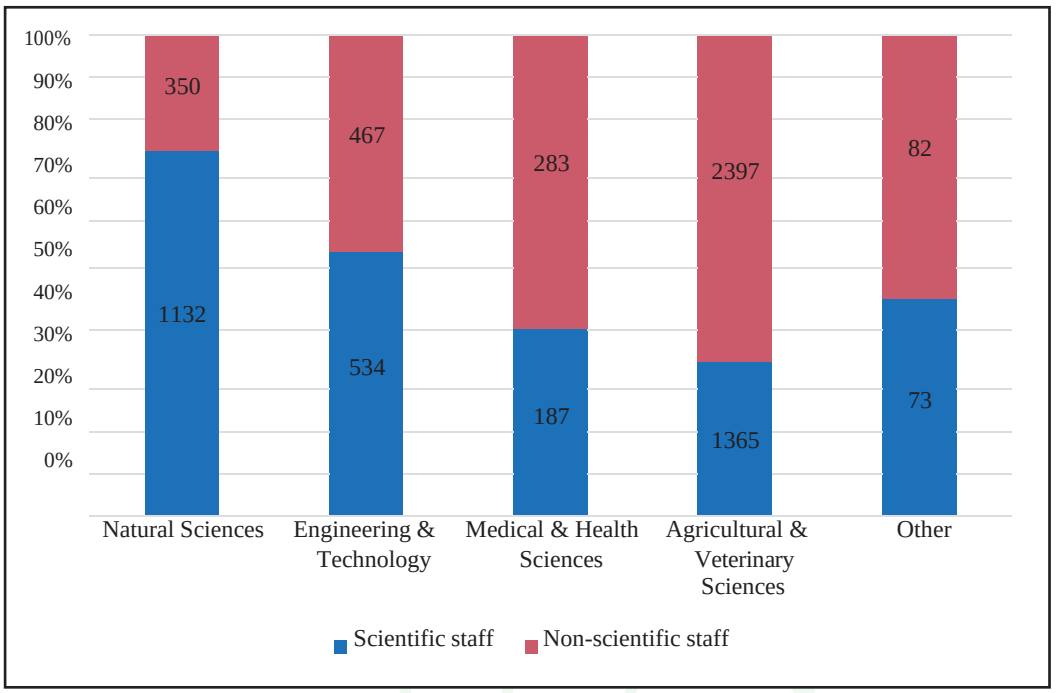


Figure 2.1: Composition of scientific and nonscientific staff by sector
(Note: The number of staff is given in the bar)

The distribution of staff employed in each sector is given in Table 2.1. Agricultural & Veterinary Sciences sector had the highest number of staff (n = 3,762, 54.8%) while the 'Other' sector had the lowest (n = 155, 2.3%).

Table 2.1: Staff strength – Distribution of staff employed in S&T institutions

Sector	Scientific staff			Accounting Staff		Administrative Staff		Other staff	Total
	Research Staff	Research Support Staff	Librarian / Information Officers	Accountants	Acc. Support Staff	Executives	Executive. Support Staff		
Natural Sciences	133	995	4	6	30	13	258	43	1,482
Engineering & Technology	295	233	6	9	44	78	143	193	1,001
Medical & Health Sciences	44	143	0	1	11	4	22	245	470
Agricultural & Veterinary Sciences	400	951	12	9	93	39	582	1,676	3,762
Other	51	17	5	3	20	4	29	26	155
Subtotal	923	2,339	27	28	198	138	1,034	2,183	**6,870**
Total	3,289			226		1,172			

The total number of research staff employed in 33 S&T institutes during 2017 was 923. The distribution of research staff among S&T institutions is given in the Figure 2.2. The lowest number of research staff was reported by Seed Certification & Plant Protection Centre (SCPPC) & Plant Protection Services (n = 3), and the highest number reported by National Building Research Organization (NBRO) (n = 128).

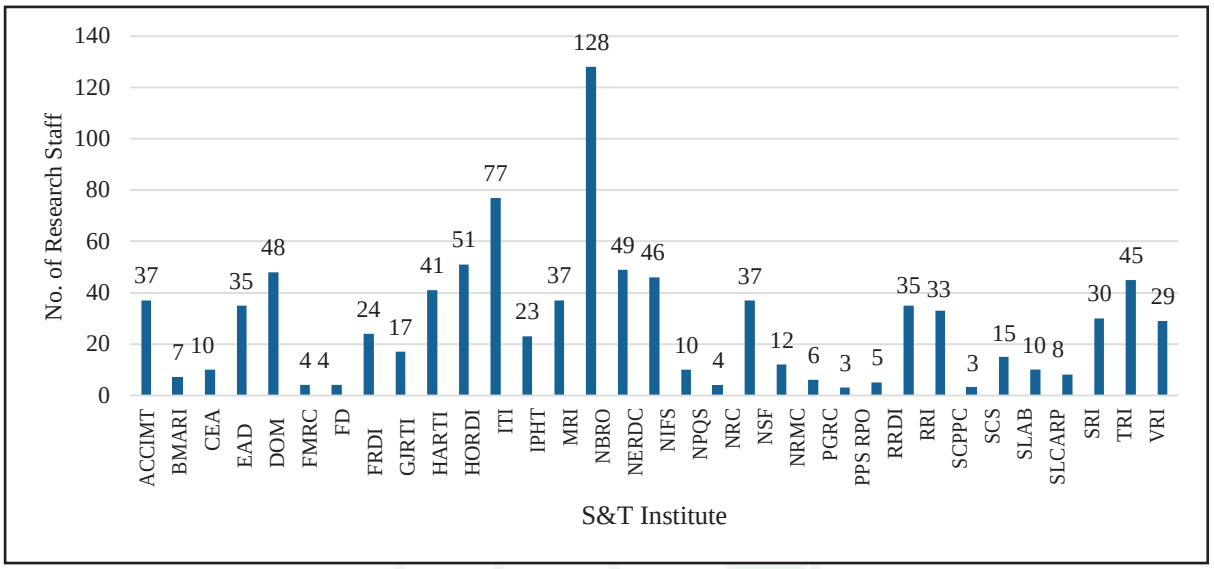


Figure 2.2: Distribution of research staff among S&T institutions

The average number of research staff per institute was 28, and 12 (36%) institutes had research staff less than 11. The range of research staff per institute is indicated in Figure 2.3. There were only three institutes (9%) with research staff of more than 51. Table 2.2 provides a list of S&T institutions according to the number of research staff.

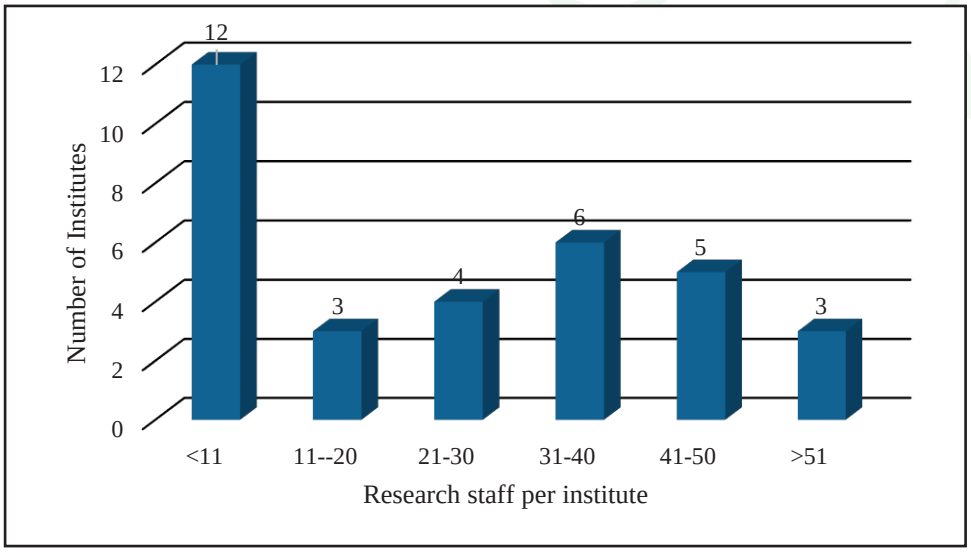


Figure: 2.3: Distribution of research staff per institute

Table 2.2: S&T institutions according to the number of research staff

Count of Research Staff					
<11	**11--20**	**21-30**	**31-40**	**41-50**	**>51**
PPS	NRMC	IPHT	RRI	HARTI	HORDI
SCPPC	SCS	FRDI	EAD	TRI	ITI
FD	GJRTI	VRI	RRDI	NIFS	NBRO
FMRC		SRI	ACCIMT	DOM	
NRC			MRI	NERDC	
RPO			NSF		
PGRC					
BMARI					
SLCARP					
CEA					
NPQS					
SLAB					

2.2 Gender composition of research staff

When considering the overall research staff (n = 923) of the 33 institutes in year 2017, 53% were females (n = 487) as indicated in Figure 2.4.

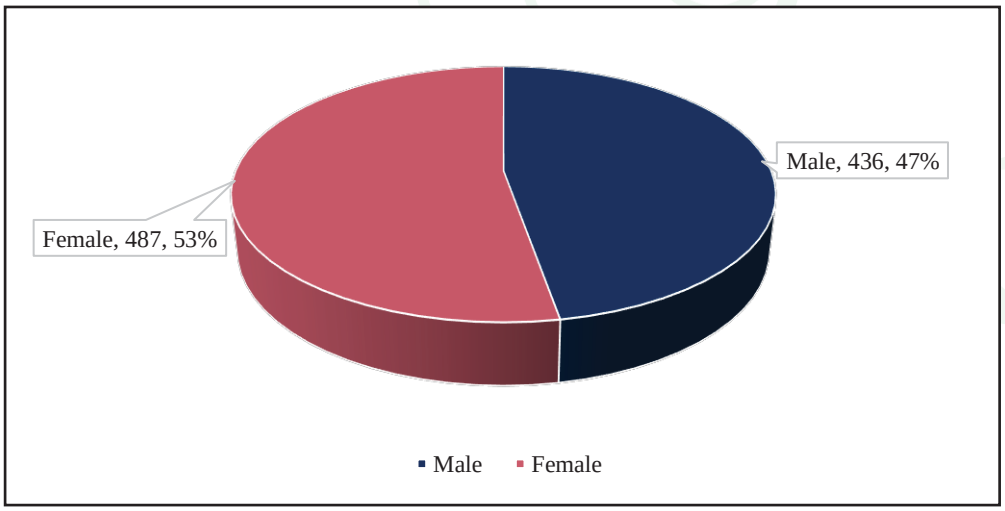
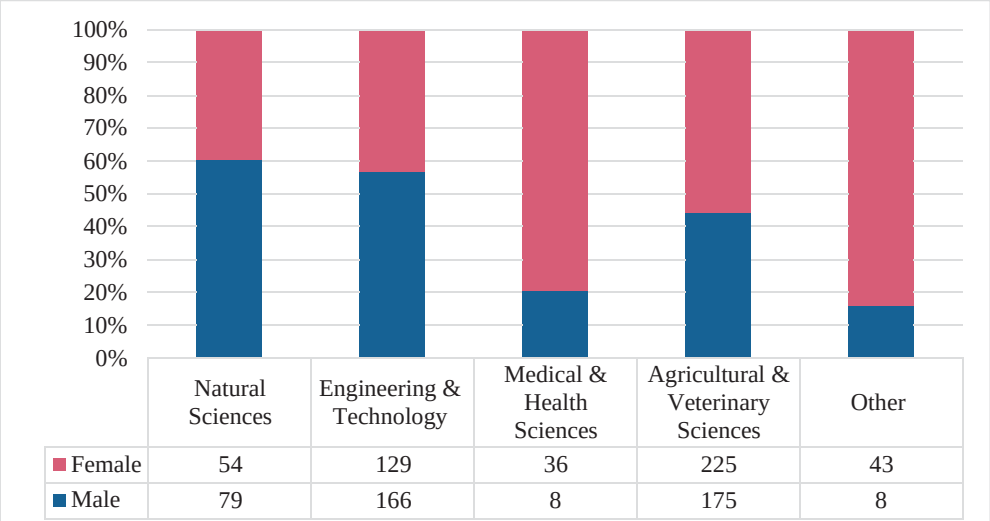


Figure 2.4: Gender distribution of research staff

2.3 Sector-wise gender distribution of research staff

Natural Sciences sector and Engineering & Technology sector were the only two sectors with a higher number of male staff over female (Figure 2.5).



	Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other
Female	54	129	36	225	43
Male	79	166	8	175	8

Figure 2.5: Gender distribution of research staff in different sectors

2.4 Area of expertise of the research staff

In the survey, areas of expertise of research staff were categorized based on OECD Fields of Research & Development (OECD, 2015) as; Natural Sciences, Engineering & Technology, Medical & Health Sciences, Agricultural & Veterinary Sciences, and Social Sciences. The highest number of research staff was working in Agricultural & Veterinary Sciences (n = 356, 38.6%), while lowest was in Medical & Health Sciences (n = 35, 3.8%) (Table 2.3).

Table 2.3: Gender-wise distribution of research staff based on areas of expertise (academic disciplines)

Field of Expertise	Male	Female	Total
Natural Sciences	151 (47.8%)	165 (52.2%)	**316 (34.2%)**
Engineering & Technology	98 (63.6%)	56 (36.4%)	**154 (16.7%)**
Medical & Health Sciences	7 (20.0%)	28 (80.0%)	**35 (3.8%)**
Agricultural & Veterinary Sciences	150 (42.1%)	206 (57.9%)	**356 (38.6%)**
Social Sciences	30 (48.4%)	32 (51.6%)	**62 (6.7%)**
Total	**436 (47%)**	**487 (53%)**	**923**

2.5 Age distribution of research staff

The highest number of research staff (n = 293) was in the age group 41-50 years and the lowest (n = 155) was in the age group <30 years as indicated in the Figure 2.6.

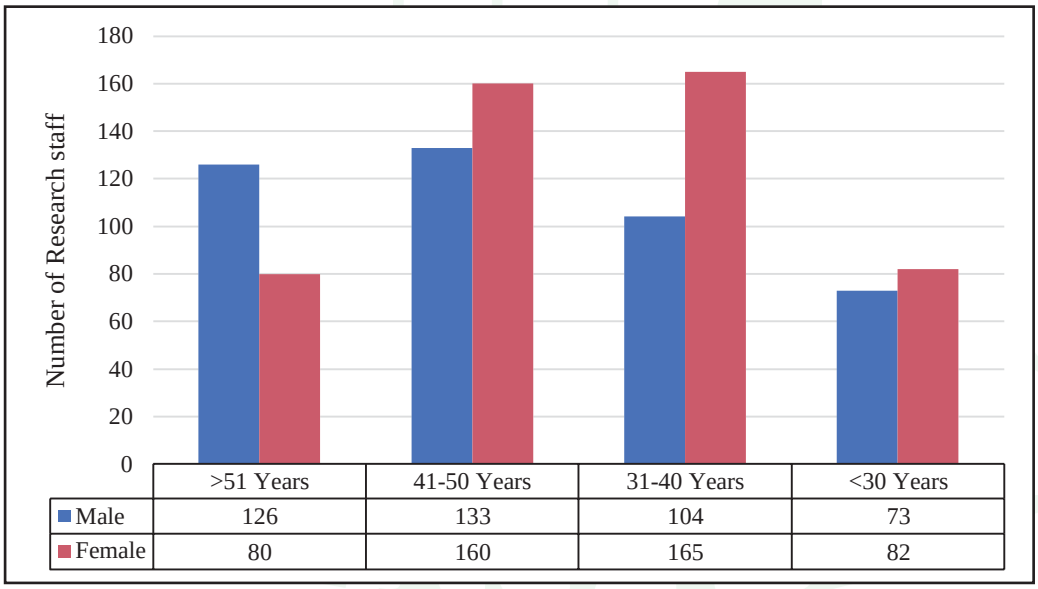


Figure 2.6: Age distribution of research staff

2.6 Highest educational qualification of the research staff

Educational qualifications of research staff include; PhD, MPhil, MSc/MA, BSc, and Diploma. The categorization of research staff based on their highest educational qualification is given in the Figure 2.7.

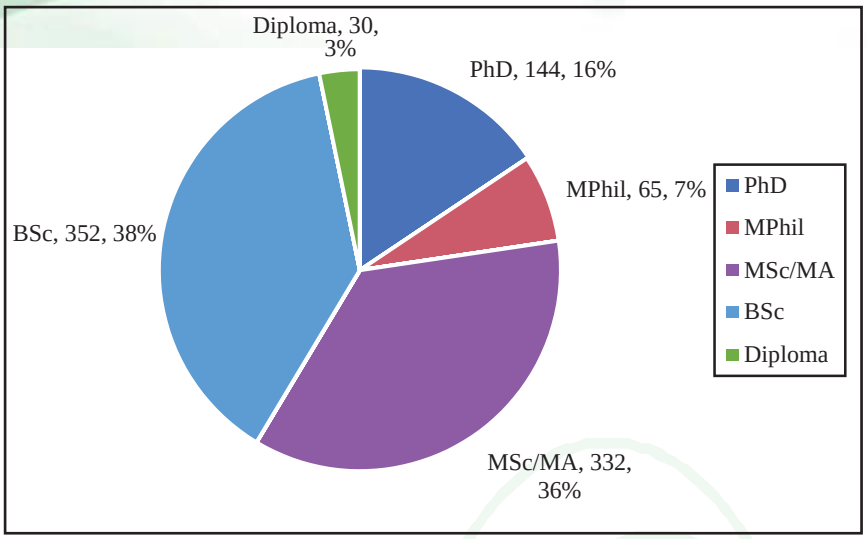
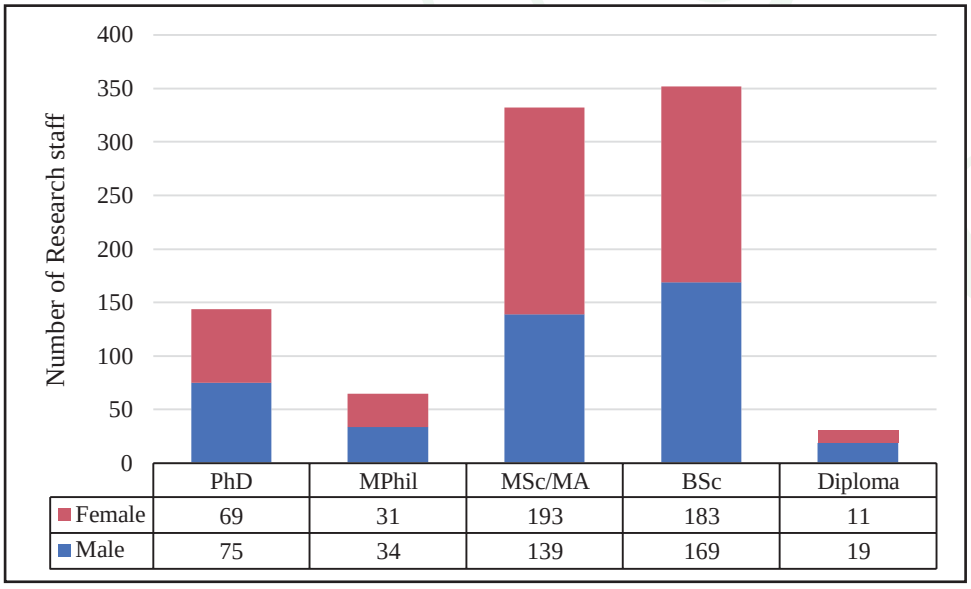


Figure 2.7: Distribution of highest educational qualification of research staff

Majority of research staff (n = 352, 38%) possessed only a Bachelor's Degree (BSc) followed by Master's Degree (MSc/MA) (n = 332, 36%). Only 7% of research staff (n = 65) had a MPhil Degree, while 16% (n = 144) had a PhD. Diploma holders reported the lowest figure (n = 30, 3%).

Figure 2.8 indicates the gender – wise distribution of highest educational qualification of research staff.



	PhD	MPhil	MSc/MA	BSc	Diploma
Female	69	31	193	183	11
Male	75	34	139	169	19

Figure 2.8: Distribution of gender-wise highest educational qualification of research staff

2.7 Human Resource Development (HRD)

2.7.1 Workshops, seminars & conferences (local & international)

Continuing professional development (CPD) involves maintaining and enhancing the knowledge, skills and experience related to a person's professional activities following completion of their formal training. The scientific staff of surveyed S&T institutes undertake CPD through workshops, seminars and conferences.

During the year 2017, a total of 2,873 scientific staff participated in local (n = 269) and foreign training programs (n = 332) (Figure 2.9).

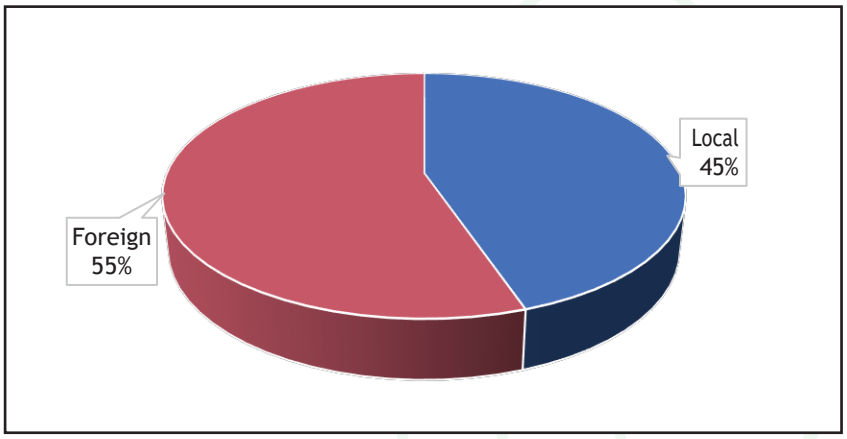


Figure 2.9: Composition of staff training programs (local & foreign)

Figure 2.10 indicates sector-wise distribution of local & foreign training programs given to scientific staff.

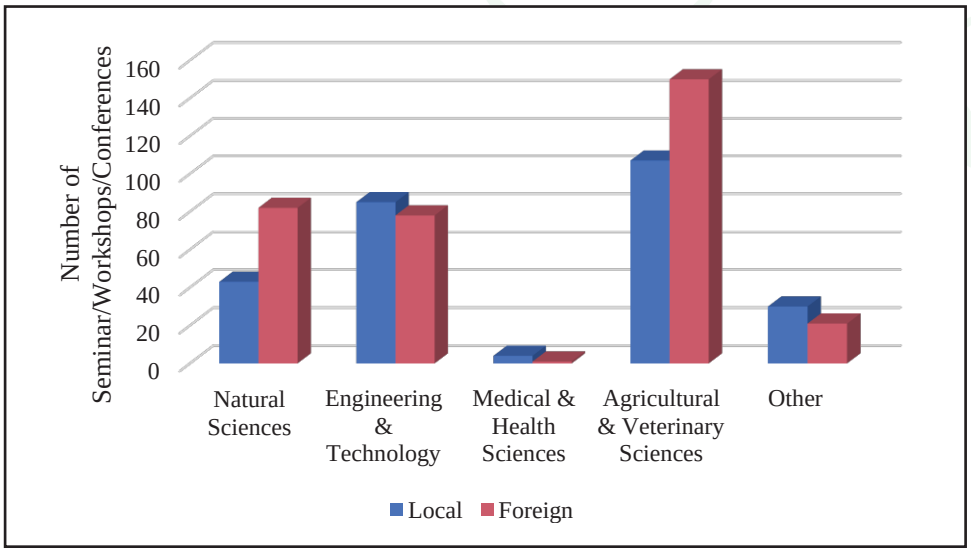


Figure 2.10: Sector-wise distribution of training programs for scientific staff

From the total 2,873 of scientific staff who participated in training programs, 2,397 (83%) participated in local training while 476 (17%) participated in foreign countries. This includes; research staff (n = 1,466), research support staff (n = 1,385), and librarian/information officers (n =22) (Figure 2.11).

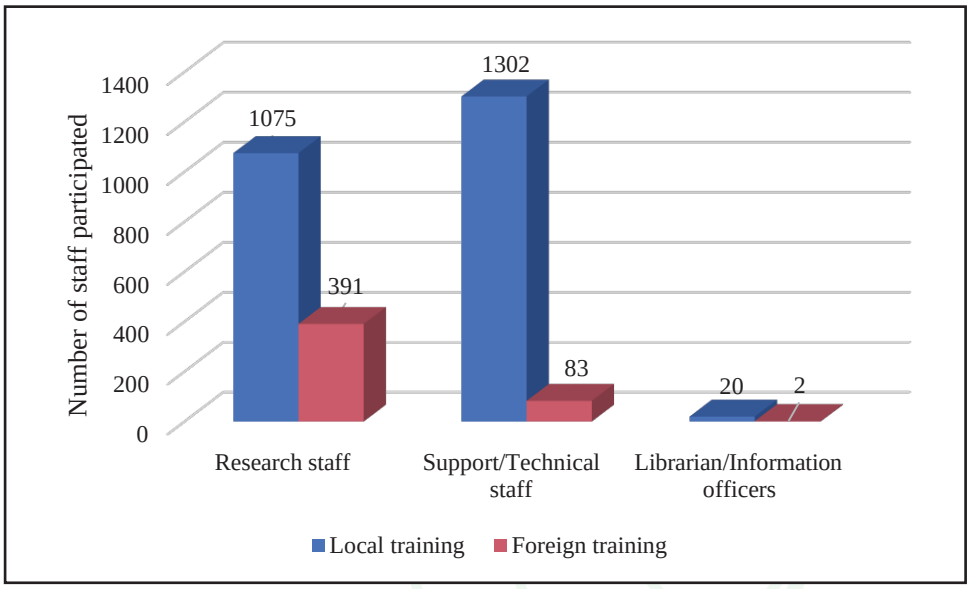
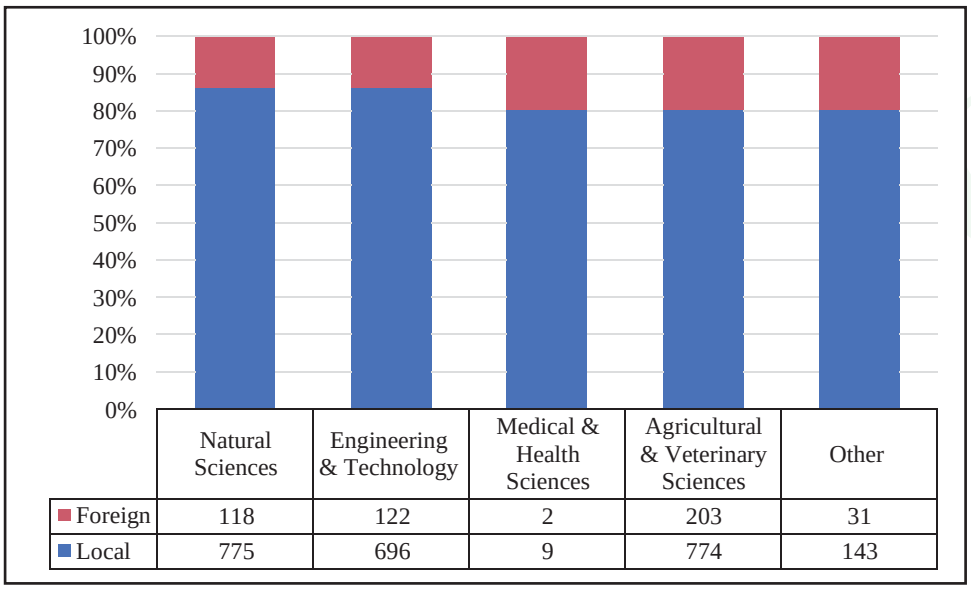


Figure 2.11: Training opportunities received by different scientific staff categories

Figure 2.12 indicates sector-wise distribution of scientific staff who participated in local & foreign training programs.



	Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other
Foreign	118	122	2	203	31
Local	775	696	9	774	143

Figure 2.12: Sector wise distribution of staff trainings

2.7.2 Employee turnover of Scientific Staff

Employee turnover refers to the number or percentage of workers left an organization and got replaced by new employees. Table 2.4 indicates the number of scientific staff recruited by S&T institutes within the year 2017.

Table: 2.4: Sector - wise distribution of recruitment of scientific staff

Scientific Staff Category	Sector					Total
	Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other	
Research staff	13	31	1	33	1	**79**
Support/Technical staff	30	37	0	54	0	**121**
Librarian/Information officers	0	1	0	0	0	**1**
Total	**43**	**69**	**1**	**87**	**1**	**201**

Within the year 2017, a total of 201 scientific staff was recruited by S&T institutes, which included 79 research staff, 121 research support staff, and 1 librarian/information officer.

According to the survey, there were several reasons such as; retirement, obtaining a new profession, and higher studies, which made employees to leave institutes. Table 2.5 indicates the number of scientific staff who left S&T institutes during year the 2017.

Table 2.5: Sector - wise distribution of scientific staff who left the institutions

Scientific Staff Category	Sector					Total
	Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other	
Research staff	8	29	4	22	4	**67**
Support/Technical staff	25	13	0	39	0	**77**
Librarian/Information officers	0	0	0	3	0	**3**
Total	**33**	**42**	**4**	**64**	**4**	**147**

During the said year, a total of 147 scientific staff left S&T institutes due to either of above mentioned reasons. This includes 67 research staff, 77 research support staff, and 3 librarian/information officers.

2.7.3 Funding for higher studies

The number of scientific staff who got offers for higher studies by their institutions is given in the Table 2.6.

Table 2.6: Number of scientific staff who was supported by the S & T institutions for their higher studies

Degree funded by the institution	Natural Sciences	Engineering & Technology	Medical & Health Sciences	Agricultural & Veterinary Sciences	Other	Total
PhD	0	4	0	10	3	17
MPhil	0	4	0	8	0	12
MSc	5	2	0	1	6	14
Postgraduate Diploma	0	2	0	3	0	5
TOTAL	**5**	**12**	**0**	**22**	**9**	**48**

A total number of 48 scientific staff was funded by their respective institutions to pursue postgraduate studies (5- Postgraduate Diplomas, 14 - MSc Degrees, 12 – Mphil Degrees, 17 - PhD Degrees). Highest number of such funding was from Agricultural & Veterinary Sciences sector (n = 22).

2.7.4 Incentives for the scientific staff

Incentives provided to the staff by the institution give benefits for both employees and employers. Performance and productivity recognition can boost employees' morale, job satisfaction and involvement in organizational functions. As a result, employers can experience greater efficiency and an increase in productivity. It also assists in retaining qualified employees within the institute. Table 2.7 indicates the incentives given for scientific staff of each institute. Transport facility/allowance, and professional allowance were the most common incentives given by the institutions, followed by research allowance, medical insurance, and housing/ quarters.

Table 2.7: Perks given to the scientific staff of S&T institutions

Perk	No. of institutions
Research allowance	16
Medical insurance	14
Performance base incentives	2
Transport facility/allowance	20
Professional allowance	23
Housing/Quarters	15
Communication allowance	6
Language allowance	2

3. PHYSICAL RESOURCES

3.1 Infrastructure facilities

Infrastructure means, the basic facilities and installations that are essential to the functioning of an institute. When considering S&T institutions, scientific infrastructure is the key in scientific discovery and production of solutions for industry and society. Scientific infrastructure includes laboratories, testing facilities, scientific instruments and equipment, and other facilities that are required for research, development & innovation. They also include knowledge-based resources such as libraries & archives as well as information and communication technology-based facilities such as networks, databases, internet, servers and computers. Table 3.1 indicates the common infrastructure facilities available in S&T institutions.

Table 3.1: Basic infrastructure facilities found in S&T institutions

Sector	Laboratories	Workshops	Auditoriums	Libraries	Other
Natural Sciences	64	6	9	7	1
Engineering & Technology	55	7	10	5	7
Medical & Health Sciences	35	0	5	2	0
Agricultural & Veterinary Sciences	109	10	43	22	38
Other	0	5	3	1	2
Total	**263**	**28**	**70**	**37**	**48**

Common infrastructure considered in this survey were; laboratories (n = 263), workshops (n = 28), auditoriums (n = 70), and libraries (n = 37). The 'Other' infrastructure (n = 48) included testing facilities, plant nurseries, instrument rooms, training rooms, pilot plants, technical incubators, printing units, pest control farms, plant houses, screening houses, experimental farms, and animal houses.

3.2 IT related facilities

All the institutes (n = 32) except Farm Mechanization Research Centre (FMRC) had their own institutional website. Out of total S&T institutes, 24 institutes contained a database on research/ services. IT facilities in the institutes are indicated in the Table 3.2.

Table 3.2: Number of institutes with IT related facilities

Sector	Number of Institutes			
	Institutional Website	Database on Research/ Services	Internet	Other
Natural Sciences	5	4	5	0
Engineering & Technology	4	2	5	3
Medical & Health Sciences	2	1	2	0
Agricultural & Veterinary Sciences	18	15	18	1
Other	3	2	3	1
Total	**32**	**24**	**33**	**5**

3.3 ICT facilities

Distribution of basic ICT facilities among the scientific & non-scientific staff is given in the Table 3.3. Total number of personal computers given to scientific staff was 1,583 (61%) and 994 (39%) to non-scientific staff. Overall, the scientific staff had access to more ICT facilities than the non- scientific staff.

Table 3.3: ICT facilities available in S&T institutions in 2017

Sector	Computers		Printers		Scanners		Other IT facilities	
	Scientific Staff	Non-scientific staff	Scientific Staff	Non-scientific staff	Scientific Staff	Non-scientific staff	Scientific Staff	Non-scientific staff
Natural Sciences	202	104	74	44	11	6	23	1
Engineering & Technology	592	488	158	96	30	28	21	22
Medical & Health Sciences	16	18	11	14	1	2	0	0
Agricultural & Veterinary Sciences	665	324	330	166	44	26	40	27
Other	108	60	36	28	4	3	38	24
Total	**1,583**	**994**	**609**	**348**	**90**	**65**	**122**	**74**

4. RESEARCH PLANNING

Considering the planning of R&D by these institutes, the source documents referred during preparation of annual action plan of the institute were queried. The main documents considered as source documents were National Science & Technology Policy and National Research & Development Framework (NRDF), developed by NASTEC. From the 33 institutes surveyed, 13 institutes (39%) used National Science & Technology Policy, and 18 institutes (55%) used NRDF as one of the source documents to prepare their annual action plan. Apart from these documents, the relevant institute's Corporate Plan, United Nations Sustainable Development Goals (SDGs), National Research Priority Documents by CARP Sri Lanka, and other policies relevant to the institute or related ministry (Eg: Forest Policy referred by Forest Department; National Quality Policy referred by Sri Lanka Accreditation Board for Conformity Assessment) were used by institutions as source documents for their action plans.

When considering the National Research & Development Framework (NRDF), there are 10 focus areas (Water; Food, Nutrition & Agriculture; Health; Shelter; Environment; Energy; Mineral Resources; Textile and Apparel; ICT & Knowledge Services; Basic Sciences, Emerging Technologies & Indigenous Knowledge) under each focus area, there were 10 interventions (policy Formulation; Pure & Applied Research; Promotion of Innovation; Application of Nanotechnology; Application of Biotechnology; Application of Indigenous Knowledge; Testing, Standardization & Accreditation and Assurance of IPR; Capacity Building; Application of ICT; Popularization). Figure 4.1 indicates the number of institutes in each sector that carried out interventions related to 10 focus areas of NRDF.

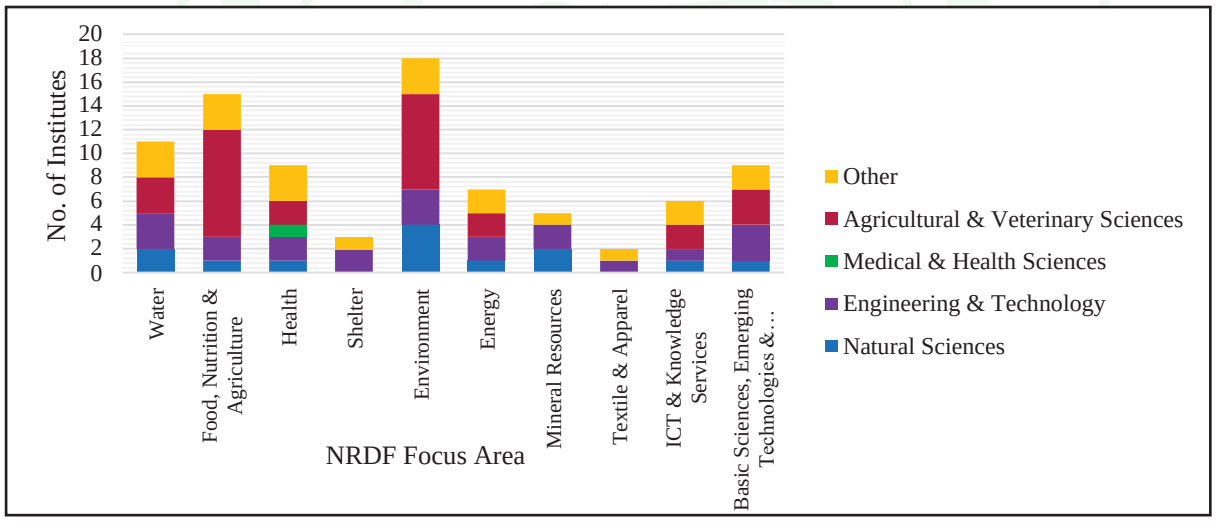


Figure 4.1: Institutes which carry out interventions related to NRDF 10 Focus Areas

Majority of institutes that carry out interventions related to NRDF was in the focus area of Environment (n = 18), followed by Food, Nutrition & Agriculture (n = 15), and Water (n = 11).

Most of the S&T institutes also adopted Sustainable Development Goals (SDGs) set by the United Nations General Assembly in 2015 for their research & development projects[5]. There are 17 SDGs and Figure 4.2 indicates future activities/projects identified by S&T institutions to address these goals.

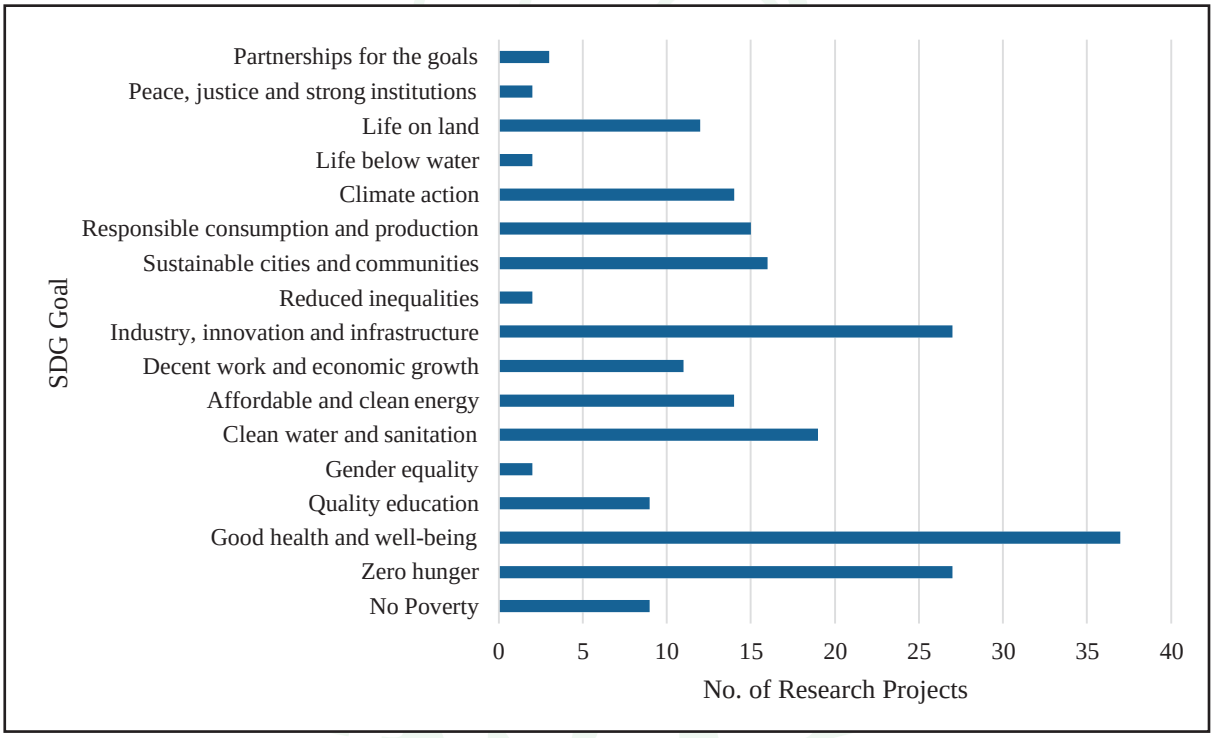


Figure 4.2: Number of future projects/activities related to SDGs

Highest number of research projects was related to the SDG's good health and well-being (n = 37), followed by zero hunger (n = 27), and industry, innovation and infrastructure (n = 27).

[5]https://sustainabledevelopment.un.org/?menu=1300

5. RESEARCH FUNDING

Funds given to S&T institutes by different funding sources (Treasury, National Science Foundation, National Research Council, Foreign sources, & other funding bodies) were divided in to four categories; Funds received for research projects, Funds received for science popularization / workshops / seminars, Funds received for upgrade of the institute (purchase of laboratory equipment, construction of buildings, renovations, purchasing of land, vehicles, buildings etc.), and Funds received for other activities. For reporting purposes, if the source of funding cannot be defined through the above said sources, then was categorized as 'Other'.

During 2017, reviewed S&T institutes received LKR 3,194.99 million from the funding sources out of which, LKR 2,943.35 million (92.12%) was spent. A sum of LKR 1,821.01 million was allocated to the institutes for research projects. Out of the total received amount, LKR 1,700.54 million (93.4%) had been spent. The Treasury was the main funding source for research-based activities. Agricultural & Veterinary Sciences sector received the highest amount of funds for research projects (LKR 1,233.65 million). Table 5.1 indicates the fund utilization by different sections & Table 5.2 indicates funds provided by different funding sources for the research projects.

Table 5.1: Funds received for research projects: distribution among identified sectors

Sector	Funds Received (LKR Mio.)	Funds Spent (LKR Mio.)	% Utilization
Natural Sciences	246.513	234.415	95.1
Engineering & Technology	42.3	42.3	100.0
Medical & Health Sciences	19.5	18.97	97.3
Agricultural & Veterinary Sciences	1,233.654	1,126.683	91.3
Other	279.041	278.171	99.7
Total	**1,821.008**	**1,700.539**	**93.4**

Table 5.2: Funds received for research projects from different funding sources

Funding source	Funds Received (LKR Mio.)	Funds Spent (LKR Mio.)	% Utilization
Treasury	1,525.093	1,515.971	99.4
NSF	14.133	7.019	49.7
NRC	0	0	0
Foreign	67.21	61.68	91.8
Other	214.572	115.869	54.0
Total	**1,821.008**	**1,700.539**	**93.4**

Figure 5.1 indicates the funds received for research projects in different sectors and their utilization.

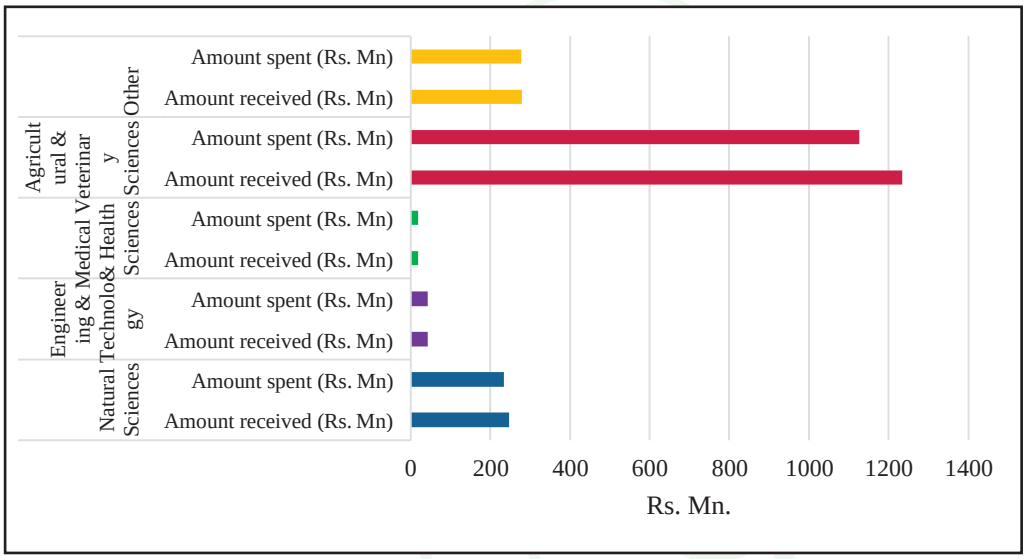


Figure 5.1: Sector – wise funds utilization in research projects

In 2017, LKR 154.6 million out of allocated LKR 164.55 million was utilized for science popularization, workshops and seminars. LKR 665.06 million was given for upgrade of S&T institutes, out of which LKR 561.8 million was spent. Upgrade of institutes include; purchase of laboratory equipment, construction of buildings, renovations, purchasing of land, vehicles, buildings etc. An amount of LKR 526.41 million was spent for other activities in the institution out of the LKR 544.36 million received. Figure 5.2 to Figure 5.6 indicate the amount of funding received and spent for different activities in the institutes.

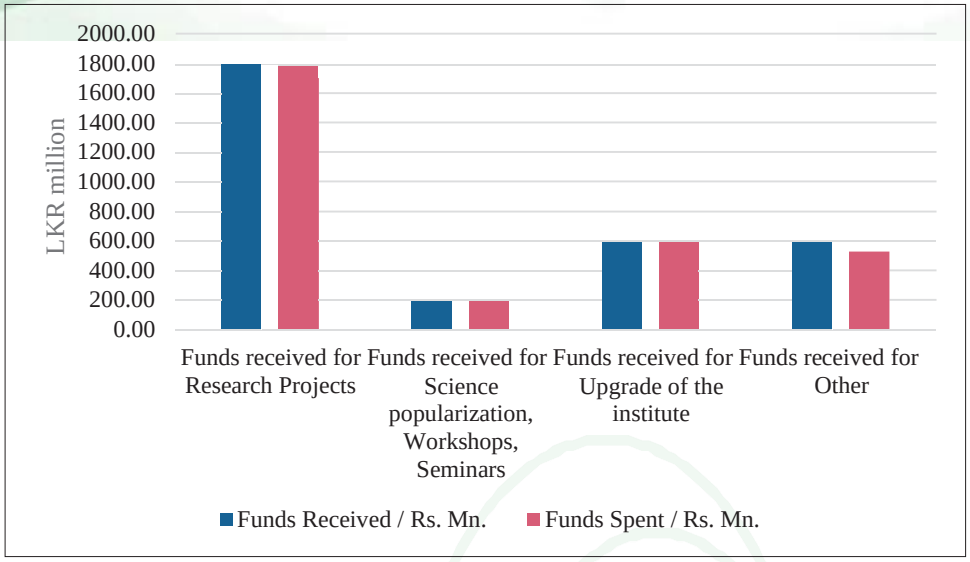


Figure 5.2: Funds received and spent by S&T institutions for different activities

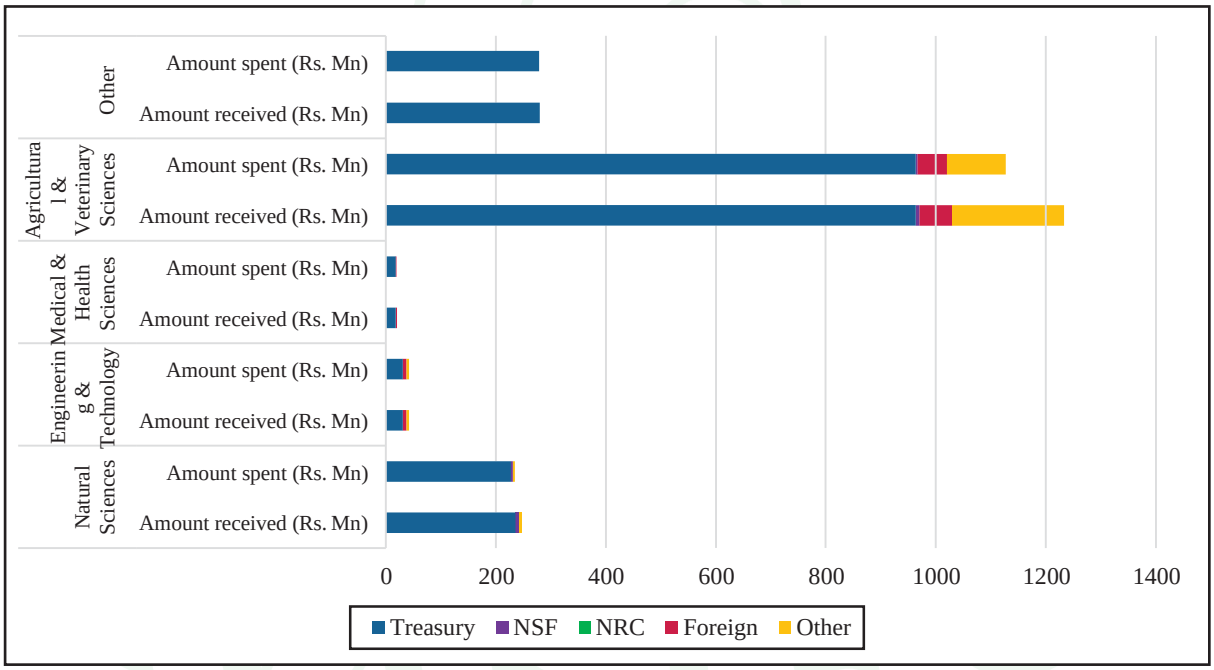


Figure 5.3: Funds received for research projects from different funding sources

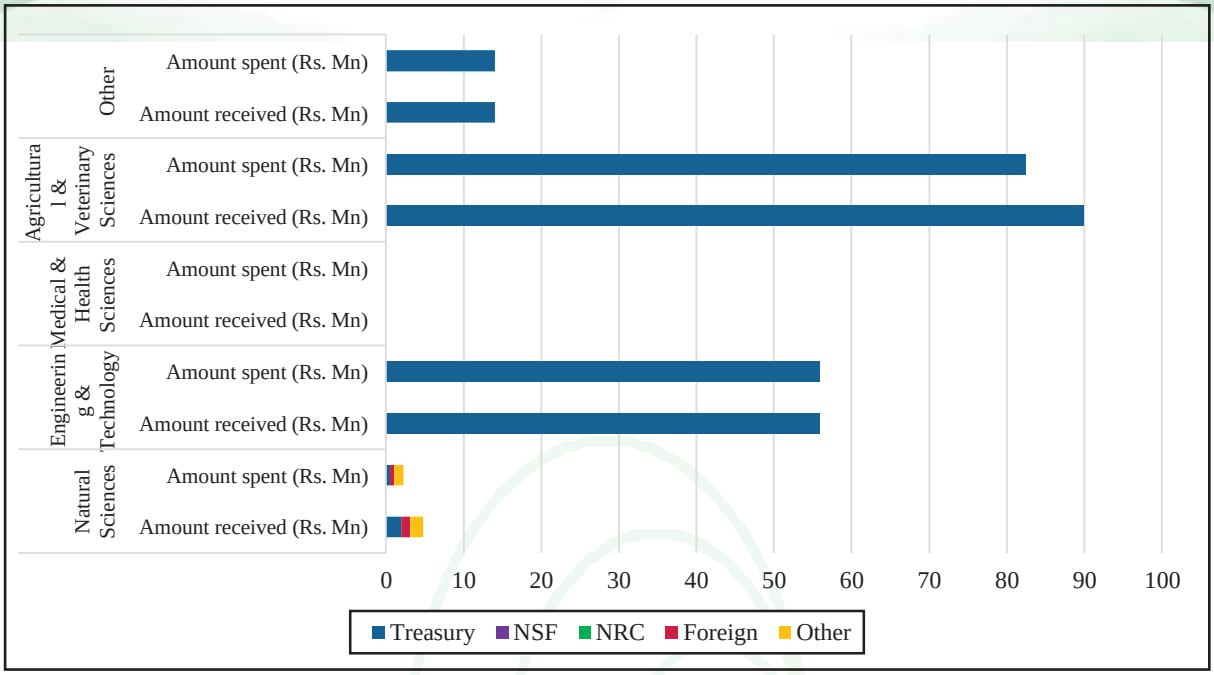


Figure 5.4: Funds received for science popularization, workshops, and seminars from different funding sources

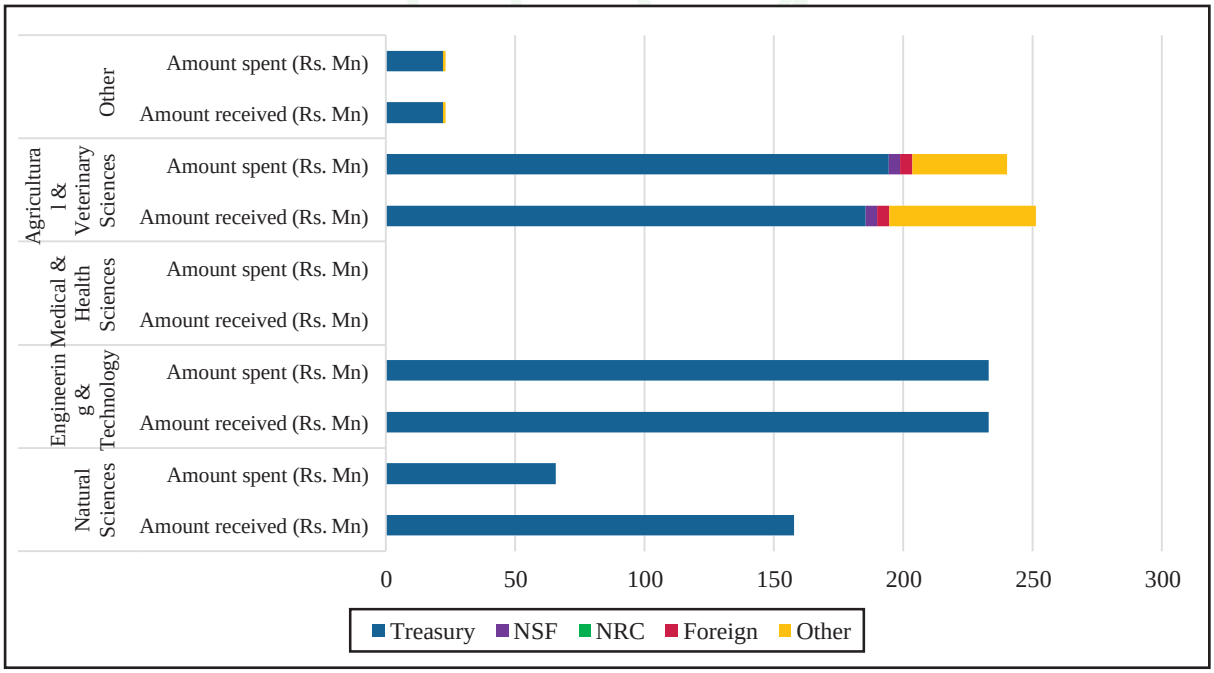


Figure 5.5: Funds received for the upgrade of the institute from different funding sources

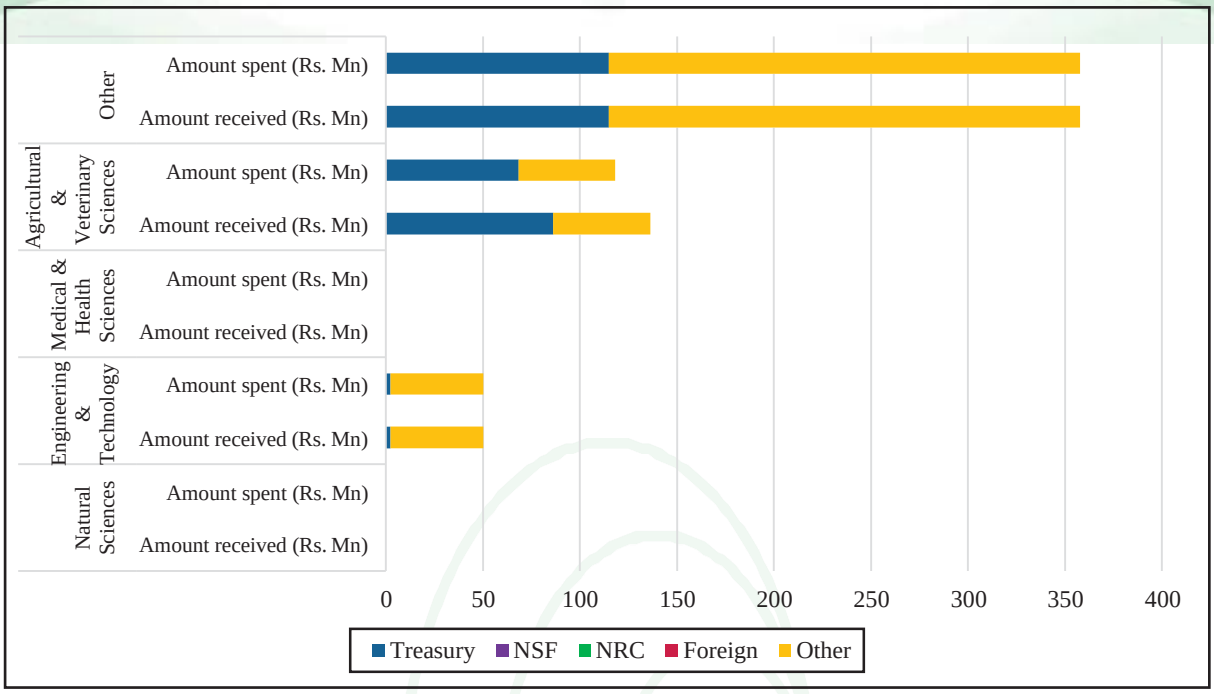


Figure 5.6: Funds received for other activities from different funding sources

Certain amount of fund was not spent or utilized within the year due to various reasons such as; lack of human resources (researchers, technical staff, support staff), lack of research equipment, delay in receiving funds, delay in receiving equipment / chemicals etc., delay in procurement when going through the government tender procedure, inefficient planning and coordination, administrative issues etc.

6. RESEARCH OUTPUTS

6.1 Research projects

In 2017, a total of 879 research projects had been carried out by these 33 S&T institutions. From these projects, 295 (34%) were completed within the year 2017 and 584 (66%) were ongoing and continued to 2018. Statuses of research projects conducted by S&T institutions in different sectors are given in figure 6.1.

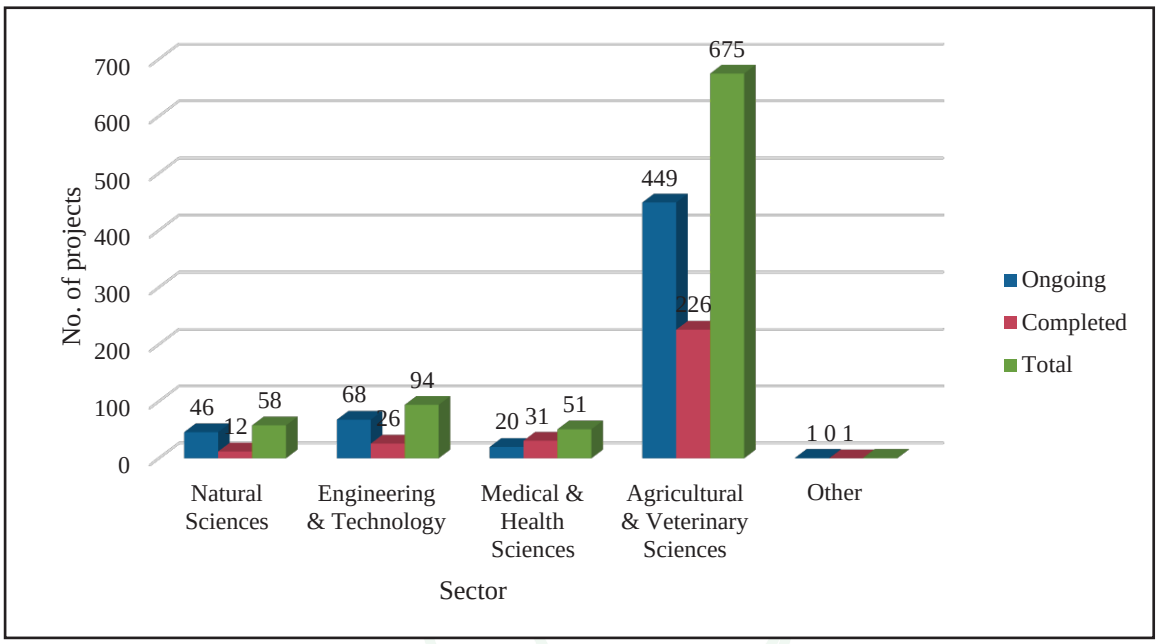


Figure 6.1: Status of research projects conducted by S&T institutions in 2017

Highest number of research projects was conducted by Agricultural & Veterinary Sciences sector (n = 675), out of which 449 (66.5%) was ongoing at the time of data collection and 226 (33.5%) was completed in 2017. The institutes that carried out the highest number of research projects were; Rice Research & Development Institute (RRDI) (205 projects), Department of Export Agriculture (EAD) (146 projects), and Tea Research Institute (TRI) (100 projects).

6.2 New products/ processes/ technologies developed through research

S&T institutes developed 52 new products, 35 new processes, and 51 new technologies during the year 2017 through their research projects. Figure 6.2 indicates the sector-wise development of products, processes, and technologies.

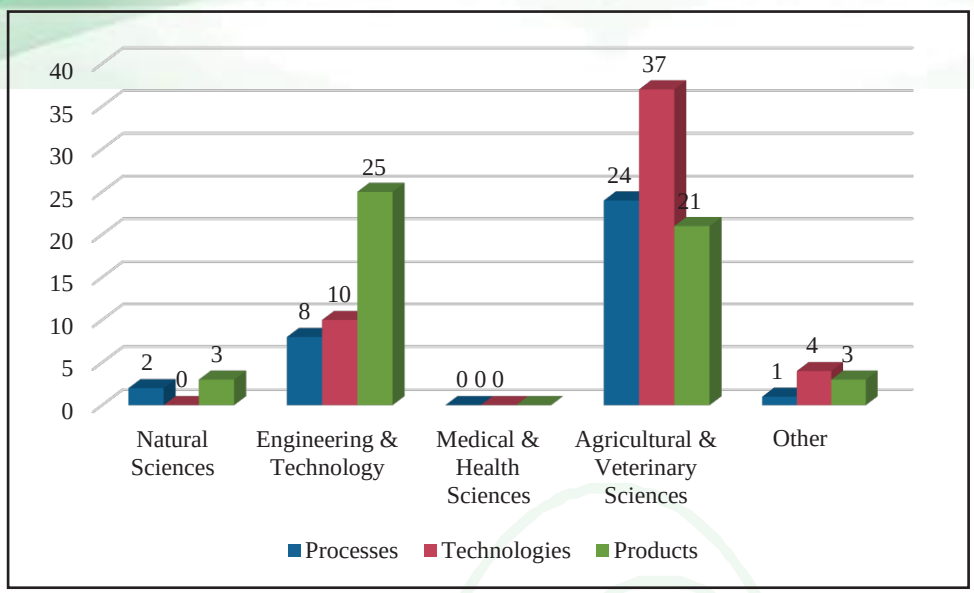


Figure 6.2: Development of new products, processes & technologies in 2017

6.3 Number of Publications

Research carried out by the institutes and their subsequent outcomes were disseminated to the society via publications, which included index journals (Science Citation Index & Science Citation Index Expanded), refereed journals, abstracts, monographs, books and chapters in books, bulletins, newsletters, magazines, working papers, etc. A breakdown of publications by S&T institutes published in 2017 are indicated in Table 6.1.

Table 6.1: Various scientific publications produced by S&T institutions in the year 2017

Sector	Number of Publications								
	SCI Journals	SCI extended journals	Refereed Journals	Abstracts	Monographs	Books	Chapters in Books	Others	**Total**
Natural Sciences	33	26	33	161	0	20	19	99	**391**
Engineering & Technology	2	11	29	209	1	0	1	8	**261**
Medical & Health Sciences	4	0	1	109	0	1	0	20	**135**
Agricultural & Veterinary Sciences	22	0	34	128	0	18	0	193	**395**
Other	22	4	1	69	0	2	4	17	**119**
Total	**83**	**41**	**98**	**676**	**1**	**41**	**24**	**337**	**1,301**

A total of 1,301 publications were published by the institutions surveyed. Majority of the publications was research abstracts (n = 676), which were presented at symposiums and

conferences. The highest number of publications was from Agricultural & Veterinary Sciences sector (n = 395) and Natural Sciences sector (n = 391) respectively.

6.4 Patents registered by S&T institutions

A total of 17 processed or produced were patented in 2017 by the institutes under the category of national patents. Out of them, a patent was sold and four were implemented (Table 6.2).

Table 6.2: Patents received by scientists/institutions

Sector	Number of items patented	National patents	International patents	Patent implemented	Patent sold
Natural Sciences	2	2	0	0	0
Engineering & Technology	11	11	0	3	1
Medical & Health Sciences	0	0	0	0	0
Agricultural & Veterinary Sciences	0	0	0	0	0
Other	4	4	0	1	0
Total	**17**	**17**	**0**	**4**	**1**

The institutes that received patents were; GJRTI (2 patents), ACCIMT (1 patent, 1 implemented), ITI (6 patents, 1 implemented, 1 sold), NERDC (4 patents, 1 implemented), NRC (4 patents, 1 implemented).

6.5 Awards received by scientific staff / institution

A total of 51 awards had been received by scientists, which included 44 national and 7 international awards (Table 6.3).

Table 6.3: Awards received by scientists/institutions

Sector	National awards	International awards	Total awards received
Natural Sciences	25	0	25
Engineering & Technology	1	3	4
Medical & Health Sciences	0	0	0
Agricultural & Veterinary Sciences	18	4	22
Other	0	0	0
Total	**44**	**7**	**51**

6.6 Products & processes commercialized by the institutions

In the year 2017, 47 products and 25 processes were commercialized by S&T institutions using various methods such as demonstrations to the private sector through exhibitions, mass media, and direct discussion with interested parties. Tables 6.4 and 6.5 indicate the number of processes and products commercialized by different S&T institutions respectively.

Table 6.4: S&T institutions which commercialized processes

Sector	Institute	Number of processes commercialized
Natural Sciences (n = 5)	GJRTI	5
Engineering & Technology (n = 11)	FMRC	2
	ITI	5
	NERDC	4
Medical & Health Sciences (n = 0)	None	0
Agricultural & Veterinary Sciences (n = 9)	EAD	5
	FD	1
	HORDI	1
	RRI	2
Other (n = 0)	None	0
Total		**25**

Table 6.5: S&T institutions which commercialized products

Sector	Institute	Number of products commercialized
Natural Sciences (n = 3)	DOM	3
Engineering & Technology (n = 11)	ACCIMT	1
	FMRC	5
	NERDC	5
Medical & Health Sciences (n = 0)	None	0
Agricultural & Veterinary Sciences (n = 31)	EAD	4
	FD	1
	FRDI	6
	HORDI	7
	PGRC	1
	PPS	4
	VRI	8
Other (n = 2)	NRC	1
	NSF	1
Total		**47**

Figure 6.3 indicates the number of products & processes commercialized by each sector

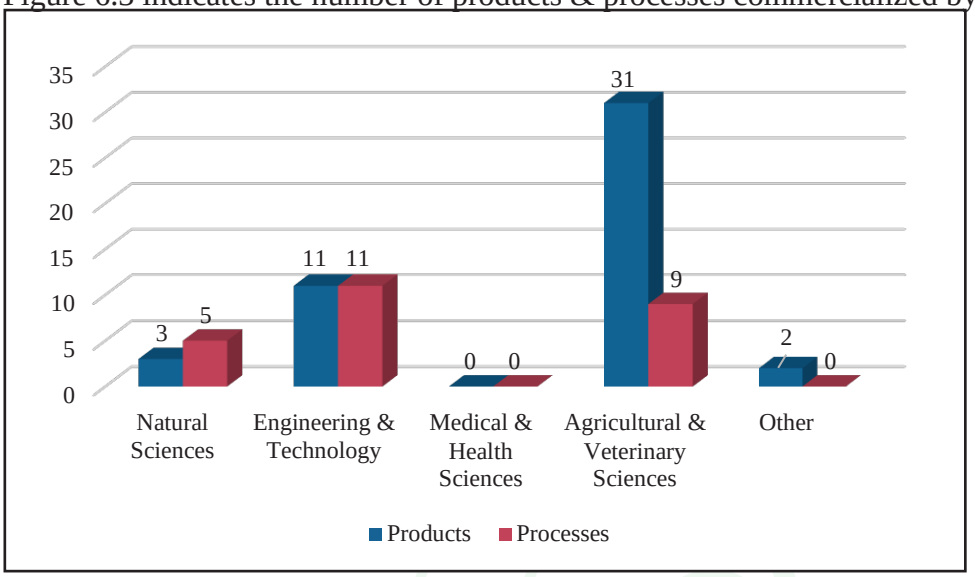


Figure 6.3: Products & processes commercialized by each sector

6.7 Technologies transferred & recommendations adopted

Technology transfer, also called transfer of technology (TOT), is the process of transferring (disseminating) technology from the places / groups of its origin to a wider audience among more people and places. It occurs along various axes: among universities, from universities to businesses, from large businesses to smaller ones, from governments to businesses, across borders, both formally and informally, and both openly and surreptitiously. It often occurs by concerted efforts to share skills, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities among governments / universities / other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services[6].

During 2017, 48 technologies were transferred (15 in Engineering & Technology sector and 33 in Agricultural & Veterinary Sciences), and 36 recommendations were adopted (20 in Engineering & Technology sector and 16 in Agricultural & Veterinary Sciences).

Figure 6.4 indicates the number of technologies transferred &recommendations adopted by each sector.

[6]https://en.wikipedia.org/wiki/Technology_transfer

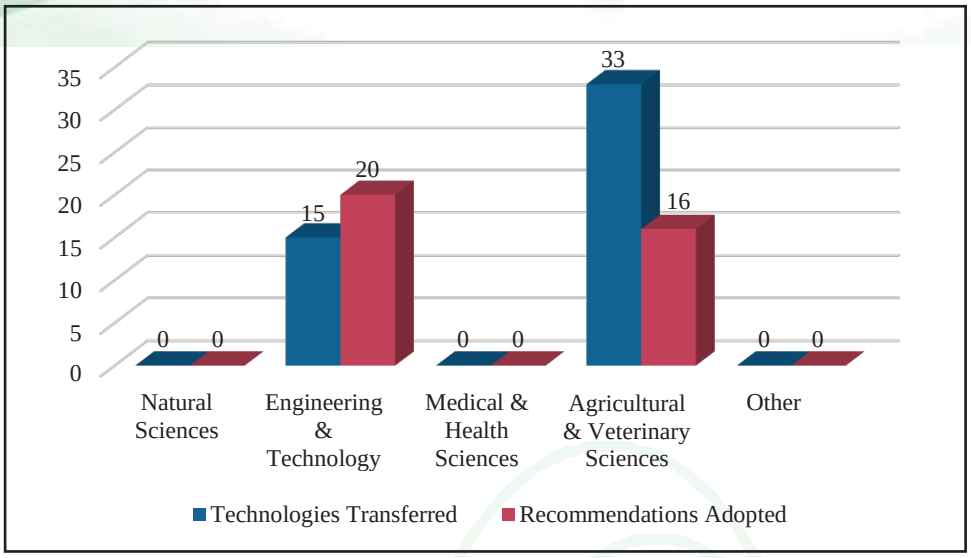


Figure 6.4: Technologies transferred & recommendations adopted by each sector

There were several barriers faced by institutions during technology transfer processes such as; poor linkage between R&D sections and the industry, lack of trained staff for technology transfer, lack of funds and inputs, low priority given due to not being included in institutional mandate, unwillingness of investors, etc.

7. SERVICES PROVIDED BY S&T INSTITUTIONS

Most of the S&T institutes surveyed are mandated to provide different services to different groups such as industries, farmers, other S&T institutions, and public. The services provided by S&T institutions include product testing, analytical service, calibration of equipment, training, product and process certification, accreditation services, and consultancies.

Number of clients served by S&T institutions under different services and the total revenue earned by each sector for these services during 2017 are given in Table 7.1.

Table 7.1: Number of clients served under different services by S&T institutions

Sector	Testing	Calibration	Training	Product and Process Certification	Accreditation Services	Consultancies	Other Services	Revenue Earned (LKR Mio.)
Natural Sciences	1,117	0	35,814	0	0	333	34	41.197
Engineering & Technology	15,922	6,846	500	40	0	4,739	1,850	769.318
Medical & Health Sciences	260,995	0	1,000	0	0	31,966	56,705	10
Agricultural & Veterinary Sciences	44,703	0	33,088	302	0	374	7,235	52.365
Other	0	0	817	0	81	0	0	36.04
Total	**322,737**	**6,846**	**71,219**	**342**	**81**	**37,412**	**65,824**	**909**

The highest number of clients was served under product testing services (n = 322,737) followed by training (n = 71,219). Medical & Health Sciences sector served the highest number of clients (n = 350,666) but the highest revenue was earned by Engineering & Technology sector (LKR
769.318 million). S&T institutes of all the sectors served a total of 504,461 clients in the year 2017 and a total revenue of LKR 909 million was earned through client-based services. It should be noted that some S&T institutes provided their services free of charge. Table 7.2 indicates the levels of revenue generated by different S&T institutes.

Table 7.2: Revenue generated by S&T institutes in 2017

Revenue generated			
LKR Mio. 0-9	LKR Mio. 10-20	LKR Mio. 21-100	LKR Mio. >100
GJRTI	CEA	NERDC	ITI
FMRC	DOM	TRI	NBRO
EAD	ACCIMT	SLAB	
FRDI	MRI		
HORDI	IPHT		
VRI			

RECOMMENDATIONS

Recommendations are classified under following identified areas.

Institutional Coordination

- The state funded S&T institutions in Sri Lanka fall under several ministries of the government. Each institution functions under the purview of related line ministry and has their own action plan. Even though the S&T institutions under the same ministry may have a certain level of coordination and communication, the coordination between institutes of different ministries are almost non-existent. Therefore, it is essential to establish an Inter-Ministerial Committee with the Head of State as the Chairman and the ministers who have S&T related institutes under their ministry as committee members to direct, coordinate and monitor state S&T institutes. The Ministry of Science, Technology & Research can be the executive arm of the committee and NASTEC can perform the institution monitoring function. This is one of the recommendations in the 2008 national S&T Policy.
- It is also essential to form linkages between state S&T institutes and local counterpart industries /private sector that carry out R&D activities. This will benefit in achieving national development goals via Public Private Partnerships (PPP).
- Data should be acquired from not only state funded S&T institutes but also from universities & private sector industries that perform and promote R&D activities.

Human Resources in Science & Technology

- It was observed during the survey that the number of non-scientific staff in S&T institutions of most sectors are higher than that of scientific staff. Most of the institutions have the issue of retaining their scientific staff due to various reasons such as gaps in career advancements& promotions, low remunerations, lack of incentives/ restriction on foreign travel etc. Recruitment process of new staff is lengthy and complicated, resulting in vacancies remaining unfilled for a prolonged period, which leads to a decrease in productivity. Most of the scientific staff leave the country for higher education and for more profitable foreign careers, resulting in brain drain.
- Therefore, it is essential to retain the scientific staff in institutes by timely recruitment, provision of merited incentives, restructuring institute organizational structure and cadre positions to pave way for career advancements, etc.

R&D Investment in Sri Lanka

- Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the collection of knowledge including knowledge of humankind, culture and society and to devise new applications of available knowledge[7]. The Gross domestic Expenditure on R&D (GERD)is the main aggregate statistic used to describe a country's R&D activities that covers all expenditure for R&D performed in the country. According to UNESCO Institute for Statistics (UIS) data, the GERD for Sri Lanka in 2015 was 0.1% of GDP[8]. Although this indicator was not measured for year 2016 and 2017, the value has not significantly changed with time. Therefore, Sri Lanka's expenditure for R&D projects and investment is very low. Inadequate human resource base to undertake R&D projects, lack of infrastructure facilities and instrumentations in R&D institutions, limited involvement of private sector in forming partnership with public S&T institutions are few of the reasons for the low GERD in Sri Lanka. The awareness of government officials and public regarding the importance of science, technology & innovation in current world is also inadequate which results in allocation of more GDP spend for less important projects. Therefore, following steps should be taken to increase R&D investment in Sri Lanka.
- Research personnel in R&D institutes should be offered national & international, advanced and modern training programs to develop their scientific and research knowledge to match the latest world R&D developments. In parallel more funds should be allocated to develop infrastructure facilities in S&T institutes, import of scientific equipment, set up incubation centers, etc. Establishment of central equipment centers will also be beneficial to share state of the art, expensive research equipment that cannot be individually acquired by S&T institutions.
- Government and public awareness on keeping up with modern science, technological and innovative trends; by increasing national S&T popularization programs, collaborations with international scientific organizations with public broadcast via

[7]OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris.
DOI: http://dx.doi.org/10.1787/9789264239012-en

[8]http://uis.unesco.org/en/country/lk?theme=science-technology-and-innovation

media, formation of public private partnerships with national & global private sector institutes etc.

- Establishment of R&D commercialization units, science & technology cells, incubation centers in S&T institutes and universities; to encourage research and development of commercially valued - marketable products / services and to promote technology transfer.

Annexure 01 – OECD classification by field of R&D**(FORD)** (OECD, 2015)

Natural sciences

- Mathematics
- Computer and information sciences
- Physical sciences
- Chemical sciences
- Earth and related environmental sciences
- Biological sciences
- Other natural sciences

Engineering and technology

- Civil engineering
- Electrical engineering, electronic engineering, information engineering
- Mechanical engineering
- Chemical engineering
- Materials engineering
- Medical engineering
- Environmental engineering
- Environmental biotechnology
- Industrial biotechnology
- Nano-technology
- Other engineering and technologies

Medical and health sciences

- Basic medicine
- Clinical medicine
- Health sciences
- Medical biotechnology
- Other medical science

Agricultural and veterinary sciences

- Agriculture, forestry, and fisheries
- Animal and dairy science
- Veterinary science
- Agricultural biotechnology
- Other agricultural sciences

Social sciences

- Psychology and cognitive sciences
- Economics and business
- Education
- Sociology
- Law
- Political science
- Social and economic geography
- Media and communications
- Other social sciences

Annexure 02 – Questionnaire format used for data collection

National Review of the Status of Science and Technology in Sri Lanka
Year 2017

Questionnaire

Objective of the Survey:

The National Science and Technology Commission (NASTEC) is mandated to submit an annual report to the Government of Sri Lanka on the status of S&T in the country. The information provided by your organization will be used only in the preparation of this report.

Please read the instructions and definitions attached to this questionnaire before you fill the questionnaire and please adhere to the format given in the questionnaire. **All the questions are relevant to activities carried out during year 2017.**

(I) GENERAL INFORMATION

1. Name of the Institution:

2. Postal Address:

3. Telephone:

4. E-Mail:

5. Fax:

6. Ministry/ Department:

7. Statutory functions: *(Please select relevant cage/s by a "x")*
You may select more than one cage depending on the nature of your mandate

R & D		S&T policy formulation	
Research funding		Technology transfer	
S&T services		Science popularization	

8. Please list any other major functions of your institution.

(II) HUMAN RESOURCES

(Please provide information on both permanent staff and staff on contract basis for more than 6 months in year 2017)

A) Staff Strength

i) Scientific, accounting & administrative staff (head count)

Staff	Total Approved Cadre Positions (Permanent staff)	Filled Cadre Positions (Permanent staff)	Staff on contract basis
Scientific			
1. Research Staff*			
2. Support Staff			
3. Librarians, Information Officers			
Accounting			
1. Accountants			
2. Support Staff			
Administration			
1. Executives			
2. Support Staff			
Other			
TOTAL			

***** *Research staff should include research officers, scientific officers, engineers and research scientists. Total filled number of permanent cadre positions and staff on contract basis in Research staff in (i) should tally with the total values of (ii), (iii) and (iv).*

ii) Research staff* based on areas of expertise & gender (head count)

Area	Male	Female	Total
Natural Sciences			
Engineering & Technology			
Medical & Health Sciences			
Agricultural & Veterinary Sciences			
Social Sciences			
Other *(specify)*			
TOTAL			

iii) Highest level of qualification of research staff* based on gender (head count)

Area	Male	Female	Total
Doctoral Degree			
MPhil Degree			
MSc/MA Degree			
Bachelor's Degree			
Diploma			
TOTAL			

iv) Research staff* by age group and gender (head count)

Age (years)	Male	Female	Total
> 51			
41 - 50			
31 - 40			
< 30			
TOTAL			

iv)Staff remunerations

Categories of scientific staff	Salary scale	Minimum qualification sought at recruitment
Research Fellow		
Senior Research Officer		
Research Officer		
Scientific Officer		
Information Officer		
other		

B) HR Development

i) Scientific staff trained at workshops, seminars and conferences (local and international)

(Head count) (*Please attach a separate sheet if necessary*)

Titles of training programmes	Duration *(In Days)*	Number Participated			Local / Foreign
		Research staff	Support / Technical staff	Librarian / Information officers	

ii) Postgraduate degrees funded by institution for scientific staff within 2017 (head count)

Degree program	Research staff	Support / Technical staff	Librarian / Information officers	Duration
Doctoral Degree				
MPhil Degree				
MSc/MA Degree				
Postgraduate Diploma				

iii) **Scientific staff recruited by the institution within the year** *(excluding transfers among regional centers of the same institution)*

Category	Highest qualification	Number
Research staff		
Support / Technical staff		
Librarian / Information officers		

iv) Scientific staff that left the institution within the year *(excluding transfers among regional centers of the same institution)*

Category	Reasons for leaving	Number
Research staff	Retirement	
	Obtained a new Job - local	
	Obtained a new Job - Foreign	
	Personal	
	Higher Studies	
	Other ……	
Support / Technical staff	Retirement	
	Obtained a new Job - local	
	Obtained a new Job - Foreign	
	Personal	
	Higher Studies	
	Other ……	
Librarian / Information officers	Retirement	
	Obtained a new Job - local	
	Obtained a new Job - Foreign	
	Personal	
	Higher Studies	
	Other ……	

v) Perks given to research staff

Perks	Research staff (Yes/No)	Support / Technical staff (Yes/No)	Librarian / Information officers (Yes/No)
Research allowance			
Medical insurance			
Transport facility / allowance			
Professional allowance			
Housing / Quarters			
Other (specify)			

(III) PHYSICAL RESOURCES

i) Infrastructure Facilities

Infrastructure facility	Number
Laboratories	
Workshops	
Auditorium/Conference Hall	
Library	
other	

ii) Other facilities

Facility	Availability (Yes/No)
Institutional website	
Database on research / services	
Internet	
other	

iii) Major equipment available *(please attach a separate sheet if required)*

Name of Equipment	Number	Year of purchase

iv) IT facilities

Facility	Number	
	Scientific staff	Administration staff
Computers		
Printers		
Scanners		
other		

(IV) RESEARCH PLANNING

I. Source documents referred in the preparation of Annual action plan of the institute

National Research and Development Framework (NRDF)	YES		NO	
National Science and Technology Policy	YES		NO	

Other Documents
(Please List)

II. NRDF based activities identified / implemented (10 focus areas & 10 interventions)

(Please select relevant cage/s by a "x")

Interventions → / Focus Areas ↓	Policy Formulation	Pure & Applied Research	Promotion of Innovation	Application of Nanotechnology	Application of Biotechnology	Application of Indigenous Knowledge	Testing, Standardization & Accreditation and Assurance of IPR	Capacity Building	Application of ICT	Popularization
Water										
Food, Nutrition & Agriculture										
Health										
Shelter										
Environment										
Energy										
Mineral										
Resources										
Textile and Apparel										
ICT & Knowledge Services										
Basic Sciences, Emerging Technologies & Indigenous Knowledge										

III. State future activities/projects identified by your institution to address UN Sustainable Development Goals (SDGs)

SGD Goal	Future activities/projects planned	Time frame		Expected outcome
		Year if initiation	Year of completion	
1. No Poverty				
2. Zero hunger				
3. Good health and well-being				
4. Quality education				
5. Gender equality				
6. Clean water and sanitation				
7. Affordable and clean energy				
8. Decent work and economic growth				
9. Industry, innovation and infrastructure				
10. Reduced inequalities				
11. Sustainable cities and communities				
12. Responsible consumption and production				
13. Climate action				
14. Life below water				
15. Life on land				
16. Peace, justice and strong institutions				
17. Partnerships for the goals				

(v) RESEARCH INPUTS

i) Funds received during the year 2017

Funds received for	Source of funding	Amount requested (Rs. Mn)	Amount received (Rs. Mn)	Amount spent (Rs. Mn)
Research projects	Treasury			
	NSF			
	NRC			
	Foreign			
	Other			
Science popularization, Workshops, Seminars	Treasury			
	NSF			
	NRC			
	Foreign			
	Other			
Upgrade of the institute*	Treasury			
	NSF			
	NRC			
	Foreign			
	Other			
Other *(please specify)*	Treasury			
	NSF			
	NRC			
	Foreign			
	Other			

** Include purchase of laboratory equipment, construction of buildings, renovations, purchasing of land, vehicles, buildings etc.*

***ii)* If the funds received are not spent (there is a balance) what are the reasons?** *(Please select relevant cage/s by a "x")*

Reason	**Yes**	**No**
Lack of human resources (researchers, technical staff, support staff)		
Lack of research equipment		
Delay in receiving funds		
Delay in receiving equipment, chemicals etc.		
Delay in procurement		
Inefficient planning and coordination		
Administrative issues		
Other *(please specify)* …….. ……..		

(VI) RESEARCH OUTPUTS

***i)* Research Projects** *(Please attach a separate sheet if required)*

Broad area of the research projects	Name of the research project	Collaborations if any *(International, other organizations, universities)*	Expected output/ outcome	Ongoing / completed
e.g. : 1. Food science				
2. Engineering				
3. Biotechnology				

ii) **New products/ processes/ technologies developed through research during year 2017***(Please list and attach a separate sheet if required) (Please refer section VI of Guidelines)*

	Processes	Technologies	Products
Total			

iii) No. of publications

Publications	Number of publications
SCI Journals	
SCI extended journals	
Refereed Journals	
Abstracts of papers presented at conferences/symposia etc.	
Monographs	
Books	
Chapters in Books	
Others *(Please specify)* *(e.g. Bulletins, Newsletters, Magazines, Working papers)*	
Total	

iv) **Patents received by scientists/ institution** *(Please list)*

Item patented	Whether National/International	Whether implemented or sold

v) Awards received by scientific staff / institution

Award received	For what *(eg: Research, Science Popularization)*	Whether National/International

***vi)* What are the products/ processes commercialized by the institution?** *(Please list)*

Processes	Products
1. 2. 3. 4.	1. 2. 3. 4.

***vii)* How did the commercialization happen?** *(Please select relevant cage/s by a "x")*

Commercialization Process	**Yes**	**No**
Demonstrated to private sector		
Through exhibitions		
Through *mass media		
Direct discussion with interested parties		
Other *(please specify)* ……		

**broadcasting (TV, radio, film), digital (internet & mobile) & printing (newspapers, magazines, pamphlets & books)*

viii) If the institution was unable to commercialize the product/process what are the reasons/ barriers?

Reasons/ Barriers	Yes	No
No proper popularization mechanism		
Lack of trained staff		
Lack of funds		
Administrations issues		
Other *(please specify)*		

***ix)* What are the technologies transferred or recommendations developed** *(Please list)*

Technologies transferred	Recommendations developed
e.g.: New method of water filtering	*e.g. New fertilizer mixture*
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

x) What are the barriers faced in technology transfer?

Barriers	Yes	No
Poor linkage between R&D sections and the industry		
Lack of trained staff in technology transfer		
Lack of funds and inputs		
Low priority		
Unwillingness of Investors		
Not included in the existing institutional mandate		
Other *(please specify)* ……		

(VII) SERVICES (FOR INDUSTRIES, S&T INSTITUTIONS, GENERAL PUBLIC)

Types & Area of services	Number of clients served	Revenue earned (Rs. Mn)
Testing facilities *Eg: Water* *Fertilizer*		
Calibration of equipment		
Training *(list the training programmes conducted to outside sources and indicate the number participated)*		
Product/Processes Certification		
Accreditation of Services		
Consultancies		
Others		