

NATIONAL SCIENCE AND TECHNOLOGY COMMISSION

**ANNUAL REPORT OF THE
NATIONAL SCIENCE AND TECHNOLOGY COMMISSION
TO THE HON. MINISTER OF SCIENCE AND TECHNOLOGY**

2014

Prof. Dhammika Tantrigoda

The Chairman
National Science and Technology Commission
No 31/9
Dudley Senanayaka Mawatha
Colombo 08

The Honorable Minister of Science and Technology
Ministry of Science and Technology
No.408, Galle Road,
Colombo-03

Dear Sir,

Annual Report of the National Science and Technology Commission 2014

In terms of Section 5(b) of the Science and Technology Development Act No. 11 of 1994, within three months after the end of each fiscal year, the National Science and Technology Commission is required to submit an annual report to the Honorable Minister of Science and Technology, reviewing, in relation to the objects set out in section 2 of the act, the science and technology activities in Sri Lanka in the preceding year on the effectiveness of measures for the development of 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.

The Annual Report of the National Science and Technology Commission, pertaining to the year 2014, is submitted herewith in fulfillment of this obligation.

Yours sincerely,

NATIONAL SCIENCE AND TECHNOLOGY COMMISSION

Chairman

Prof. Dhammika Tantrigoda

Members

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Prof. A.A.P.S. Manamperi

Dr. S.S. Namasivayam

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Mr. D. Fernando

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Director

Dr. Muditha Liyanagedara

Senior Scientists

Mrs. Asha Pitadeniya

Mr. Indika Siriwardane

Deputy Director (Finance and Administration)

Mrs. Kumari Peiris

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Definitions

Research staff

Professionals 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.

Research supporting 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.

Exclude supporting staff such as attendants, drivers and include them under administration.

Scientific staff

Research and research supporting staff and librarians.

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.

Supporting staff non research

Secretarial, skilled/unskilled craftsman, gardeners, animal house keeper etc. directly associated with or providing services to the researcher.

Product

A product developed by the institution based on its own research.

e.g. Screw type virgin coconut oil expeller

Processes

A methodology developed to produce a product.

e.g. A new tea drying process

A new rubber vulcanizing process

Technology

An application of knowledge to give a practical capability.

e.g. GSM or CDMA technology for mobile communication

1. Public Sector S&T Institutions

National Science and Technology Commission (NASTEC) was established by the Science and Technology Development Act No. 11 of 1994 and came into operation in August 1998. It was formally inaugurated on 06th December 1998 and became a functional commission in January 1999. NASTEC has been designed to be the apex policy formulating and advisory body on science and technology matters to the Government of Sri Lanka. In addition to other tasks, the NASTEC is required to review the science and technology status of Sri Lanka in each year on the effectiveness of measures adopted for the development of 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 commission identified 28 public sector Science and Technology (S&T) institutions (Table 1) and reviewed their status.

Scope of the commission is not to discuss S&T status of individual institutions but to review their contribution towards the overall S&T status of the country. Therefore, this report does not discuss the S&T status of each institution. Instead, the institutions were categorized into four sectors as Agriculture, Plantation, Engineering and Miscellaneous and S&T status of each sector is discussed. Table 1 summaries the S&T institutions coming under each sector and the acronym used for them. The institutions categorized as the Miscellaneous sector render services and/or carryout research and developments related two or more sectors mentioned above and/or fields related to natural sciences, medical and health, etc. The Agriculture and Miscellaneous sectors have 11 institutions each and Plantation and Engineering sectors have 4 and 2 institutions respectively.

This report does not include the S&T status of private sector undertakings and National Universities. Private sector institutions dedicated solely for research and development (R&D) are rare in Sri Lanka. However, some large and medium scale private sector undertakings seem to have departments that undertake R&D activities to cater their needs.

In order to collect human resources, financial and research output data and instrumentation and technology usage of the intuitions, a questionnaire was given to each institution. An institution's contribution towards the S&T status of the country was measured on the basis of the number of local and international patents obtained, clients served, revenue generated, processes developed, etc. Staff of NASTEC visited some selected S&T institution mainly in the Agriculture and Plantation sectors and discussed the problems they are facing with top level management with a view to identify possible remedies for the issues. In order to ensure the accuracy of the assessment, each S&T intuition was requested to appoint one of their scientific or research staff as a liaison officer. The officers' responsibility was to communicate with the commission for successful completion and submission of the questionnaire on time. A workshop was held for the liaison officers at the auditorium of the Industrial Technology Institute (ITI) in Colombo on 30th January 2015 for them to give a necessary insight into accurate completion of the questionnaire. The Commission made an honorarium to each liaison officer as an incentive for the service they rendered.

Table 1. S&T institutions coming under different sectors and their acronyms

Agriculture	Plantation	Engineering	Miscellaneous
Department of Agriculture (DOA)	Coconut Research Institute (CRI)	National Engineering Research & Development Centre (NERDC)	Atomic Energy Authority (AEA)
Farm Mechanization Research Centre (FMRC)	Rubber Research Institute (RRI)	Arthur C. Clarke Institute for Modern Technologies (ACCIMT)	Gem & Jewelry Research & Training Institute (GJRTI)
Fruit Crop Research & Development Institute (FCRDI)	Sugar Cane Research Institute (SRI)		Industrial Technology Institute (ITI)
Field Crops Research & Development Institute (FRDI)	Tea Research Institute (TRI)		Institute of Fundamental Studies (IFS)
Hector Kobbekaduwa Agrarian Research & Training Institute (HARTI)			National Aquatic Resources Research & Development Agency (NARA)
Horticultural Crop Research & Development Institute (HORDI)			National Building Research Organization (NBRO)
Institute of Post-Harvest Technology (IPHT)			National Science Foundation (NSF)
Plant Genetic Resources Centre (PGRC)			Natural Resources Management Centre (NRMC)
Rice Research & Development Institute (RRDI)			Sri Lanka Accreditation Board for Conformity Assessment (SLAB)
S.L .Council for Agricultural Research Policy (SLCARP)			Sri Lanka Institute of Nano Technology (SLINTEC)
Seed Certification Service (SCS)			Veterinary Research Institute (VRI)

Except for the Medial Research Institute (MRI), other S&T institutions submitted the questionnaire to the commission. MRI did not respond to any of the commission's verbal and written reminders of the questionnaire.

The commission when collecting data gave an assurance to the institutions that it would not divulge any information which is inimical to the interests of the institutions. This is another reason why institution wise data are not discussed in this report.

SLINTEC have not provided information of their finances in 2014. Some agreements that institutions have entered into with foreign and private sector financiers may prevent them from divulging funding information to a third party. The Commission fully understand and honor such formal obligations of institutions and do not oblige to provide such information that is confidential in nature. However, it is the opinion of the Commission that, by virtue of the powers vested in the commission by the Science and Technology Development Act No. 11 of 1994, public funds given to the instructions via the general treasury, NSF and NRC should be made available to the commission by the S&T institutions. All information asked for in the questionnaire are important for accurate assessment of the S&T status of Sri Lanka.

2. Status of Human Resources

In total 835 research staff is employed in the public sector S&T institutions in Sri Lanka. Figure 2.1 shows the distribution of the research staff in each sector. The highest number of research staff is employed in the Miscellaneous sector. Female research staff is slightly higher in the Agriculture and Miscellaneous sectors than male research staff, while it is quite the opposite in the Plantation and Engineering sectors. However, the gap between the male and the female research staff is not significantly large in any sector. Therefore, the public sector S&T institutions could be considered as equal opportunity employers.

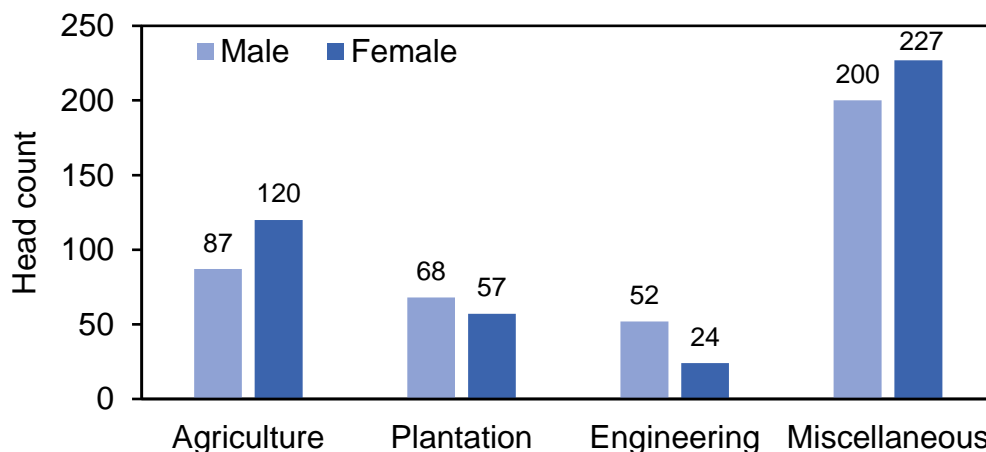


Fig. 2.1. Research staff by gender

Figure 2.2 shows the research and other staff in S&T institutions in different sectors. The research to other staff ratio is shown in the same figure as a line graph. Other employees include research support, administrative and accounting staff, librarians, etc. The Agriculture, Plantation, Engineering and Miscellaneous sectors have research to other staff ratios of 1:6, 1:8, 1:5 and 2:7 respectively. The Miscellaneous sector has the highest ratio, while the Plantation sector has the lowest.

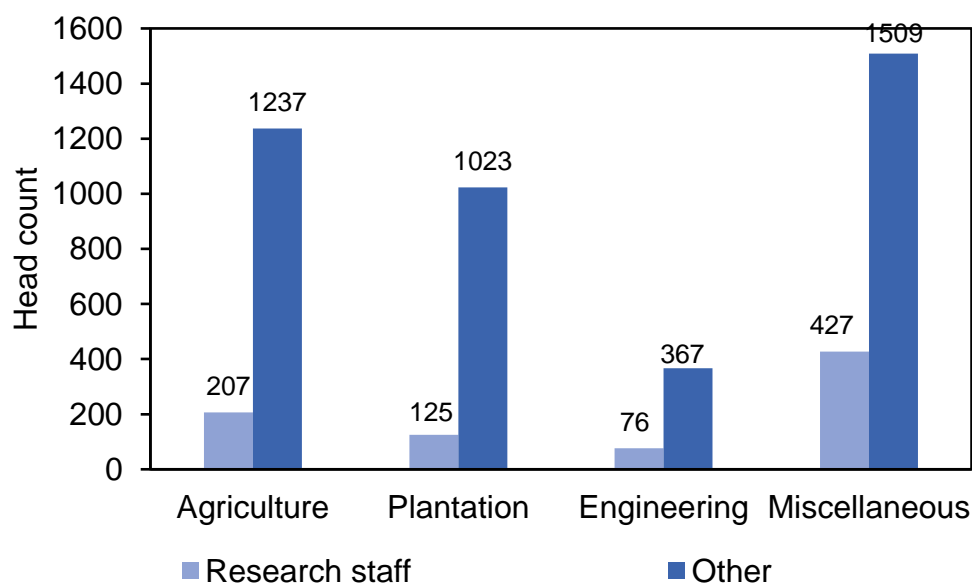


Fig. 2.2. Research staff and research to other staff ratio in S&T institutions

Agriculture, Plantation, Engineering and Miscellaneous sectors have 78, 82, 58 and 114 vacant cadre positions for research staff respectively (Fig. 2.3).

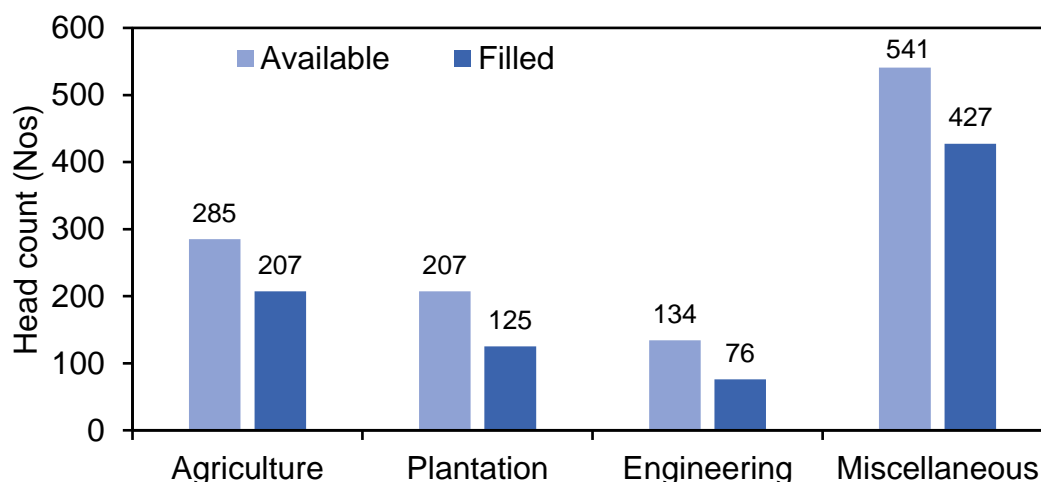


Fig. 2.3. Available and filled cadre positions of research staff in each sector

New research staff has been recruited within the year 2014. Number of recruitments are higher than the resignations and retirements in each sector within the year. Number of research staff in the Agriculture, Plantation, Engineering and Miscellaneous sectors, who left the job in the year 2014 are 7, 18, 18, and 55, respectively. These numbers include those who retired and migrated to foreign countries. However, the gap between the number of recruitments and retirements plus resignations in the Agricultural sector is relatively smaller (Fig. 2.4). Thus, research staff in S&T institutions with the exception of those in the Agricultural sector have significantly increased in 2014. The number of research staff increased within the year 2014 in the Agriculture, Plantation, Engineering and Miscellaneous sectors are 1, 11, 9 and 15, respectively. However, this increment is not sufficient to fill the vacant research staff positions in each sector.

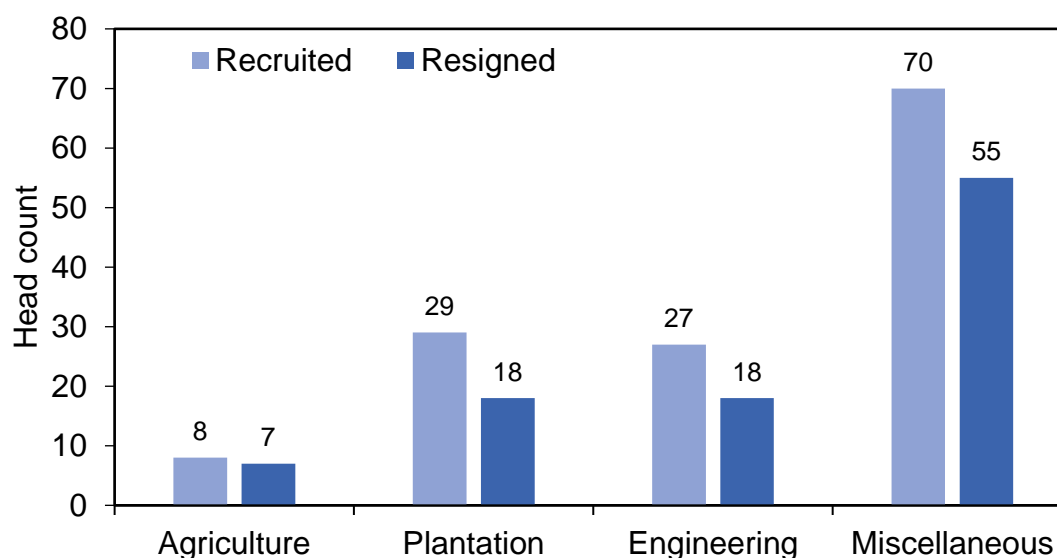


Fig. 2.4. Research staff recruited and resigned within the year 2014

Agriculture, Plantation, Engineering and Miscellaneous sectors have 194, 30, 39 and 110, respectively, vacant cadre position for research support staff (Fig. 2.5). Vacancies in the Agriculture and the Miscellaneous sectors seems to significantly larger. Tables 2.1 and 2.2 shows the filled and vacant cadre positions of accounting and administrative staff. The data shows that the discrepancy between the filled and vacant cadre positions of accounting and administrative staff is not as large as that between research and research support staff.

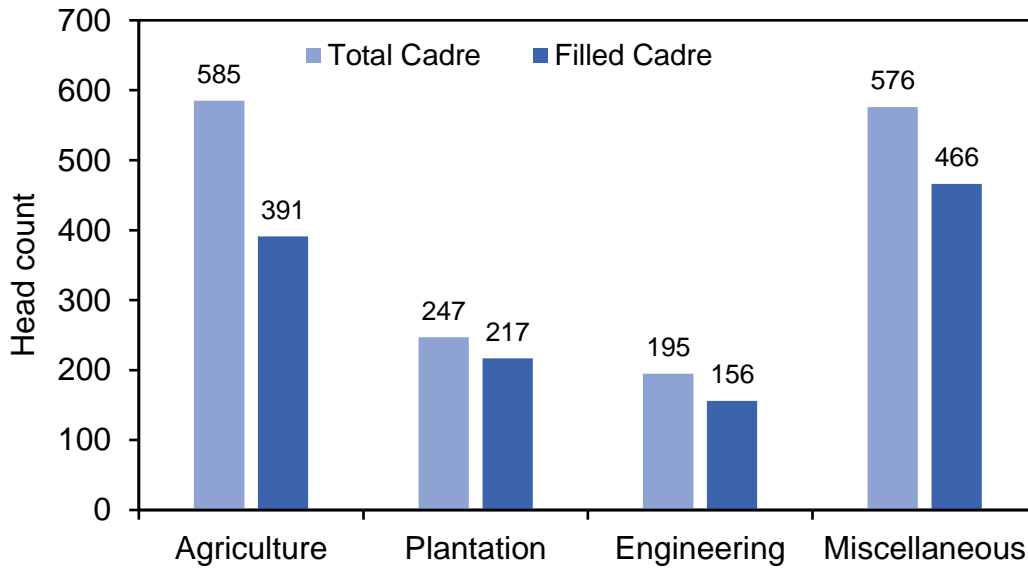


Fig. 2.5. Total and filled cadre positions of research support staff as at December 2014

Table. 2.1. Head Count –Available Cadre Positions

Sector	Scientific			Accounting		Administration		Other	Total
	Research Staff	Support Staff	Librarians/IO	Accountants	Support Staff	Executives	Support Staff		
Agriculture	285	585	13	4	29	19	196	473	1604
Plantation	207	247	6	6	56	20	147	571	1260
Engineering	134	195	3	5	26	9	71	33	476
Miscellaneous	541	576	13	20	53	80	223	357	1863
Total	1167	1603	35	35	164	128	637	1434	5203

Table. 2.2. Head Count -Filled Cadre Positions

Sector	Scientific			Accounting		Administration		Other	Total
	Research Staff	Support Staff	Librarians/IO	Accountants	Support Staff	Executives	Support Staff		
Agriculture	207	391	6	4	27	10	160	432	1237
Plantation	125	217	3	3	37	13	154	471	1023
Engineering	76	156	2	5	26	8	61	33	367
Miscellaneous	427	466	24	19	70	70	246	187	1509
Total	835	1230	35	31	160	101	621	1123	4136

56% of the research staff in the S&T institutions have post graduate qualifications. The remaining 44% have a B.Sc degree or diploma (Fig. 2.6). Except the Engineering sector, the research staff in the other sectors have Ph.D holders.

S&T institutions belonging to all sectors have more or less uniform age distribution of research staff (Fig. 2.7). However, number of research staff less than 30 years of age is anomalously low in the Agriculture sector and the highest in the Miscellaneous sector.

Naturally, the majority of research staff in the Agriculture and the Plantation sectors are agriculturalists and the Engineering sector is dominated with engineers (Fig. 2.8). Research staff in the intuitions categorized under the Miscellaneous sector is dominated with those who have specialized in natural science subjects. In additions, the research staff of this sector include engineers, agriculturalist and veterinarians. All veterinarians are employed in the Veterinary Research Institute (VRI).

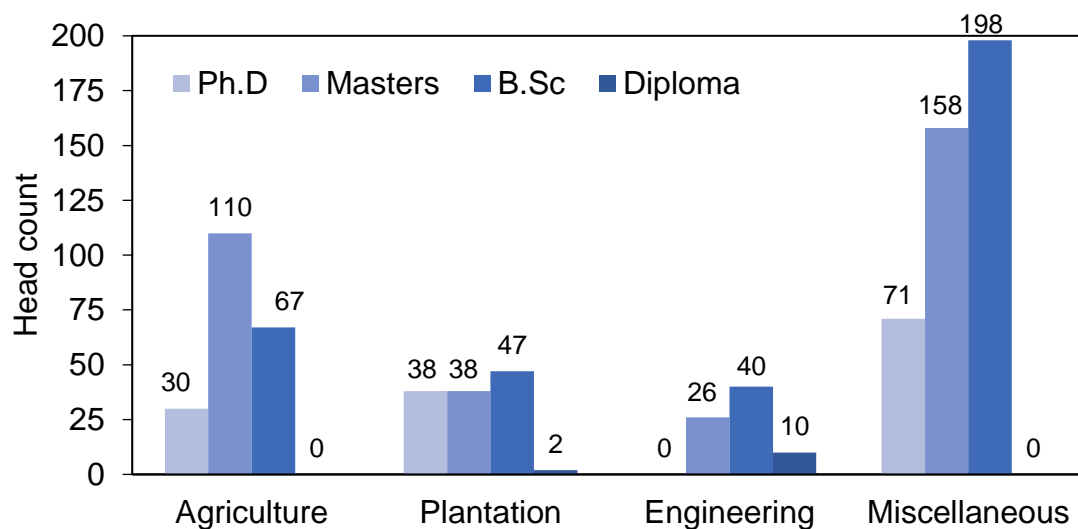


Fig. 2.6. Highest qualification of research staff in each sector

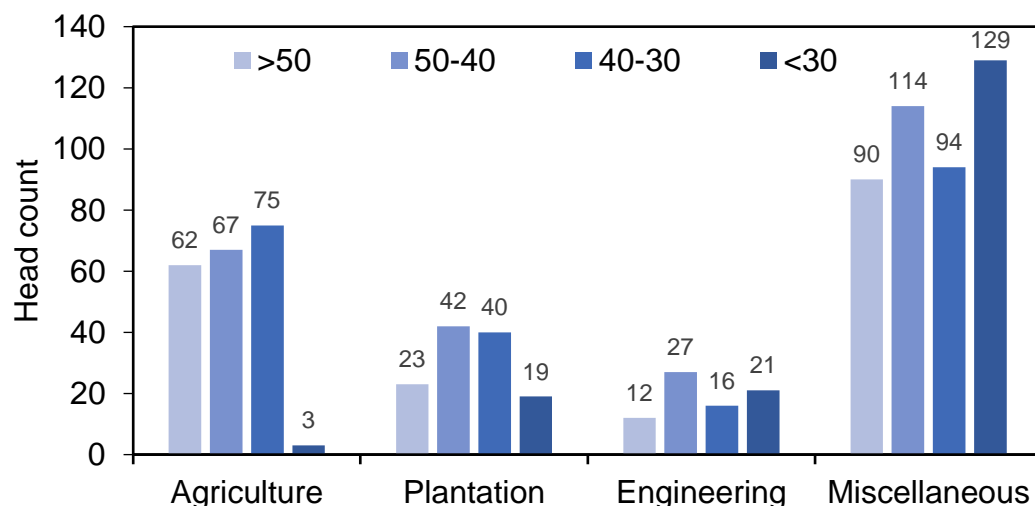


Fig. 2.7. Research staff by age group

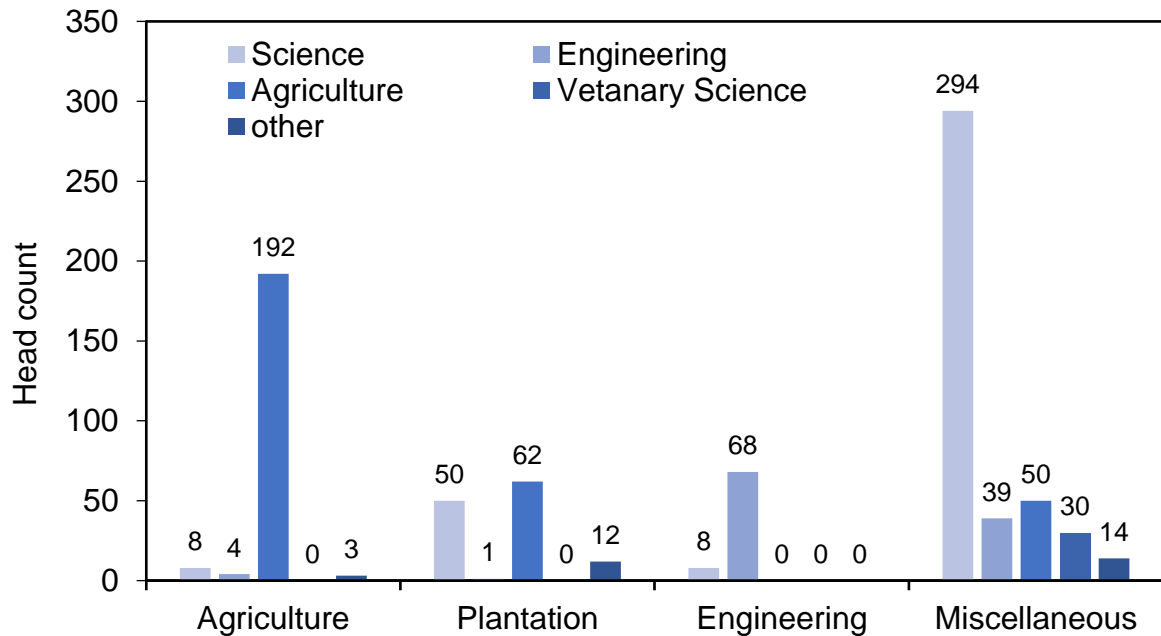


Fig. 2.8. Area of expertise of research staff in S&T institutions

S&T institutions categorized under the Agriculture, Plantation and Miscellaneous sectors have trained their staff at workshops, seminar, conferences, etc. (Fig. 2.9). The Agriculture sector seems to have given more training opportunities to their staff. Training offered to the staff in the Engineering sector is the lowest.

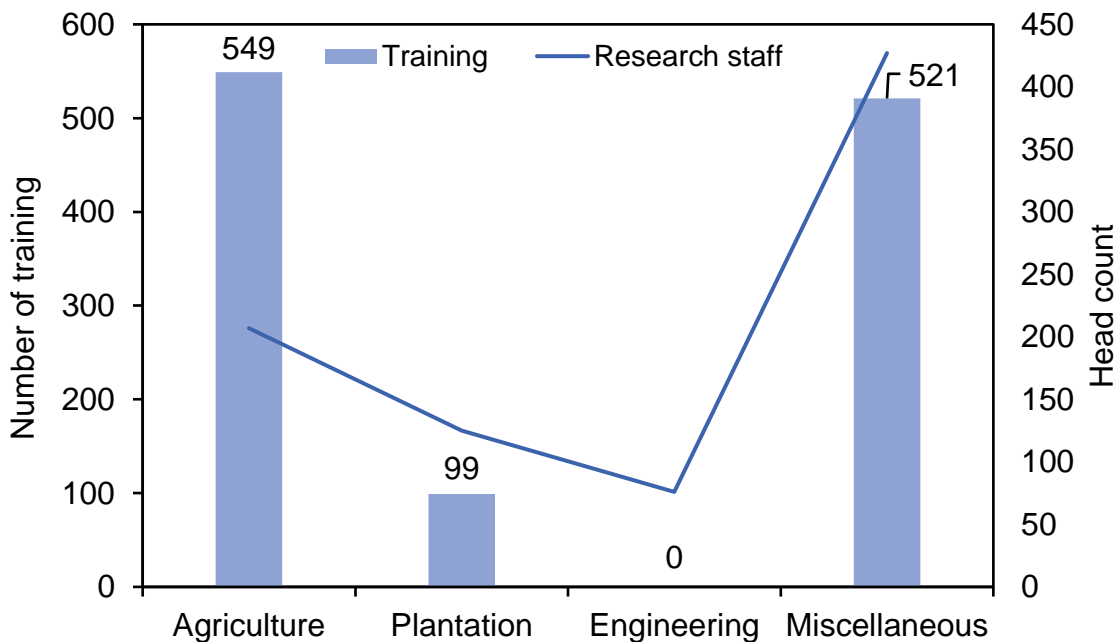


Fig. 2.9. Staff trained at workshop, seminar, conferences, etc.

Trainees include research supporting staff such as technical and scientific officers, in addition to the research staff. Number of research staff in each sector is plotted in the same graph to get an idea about the number of training per staff member.

3. Financing

3.1. Research Financing

General Treasury, National Research Council (NRC), National Science Foundation (NSF), foreign and other sources funded the S&T activities in the private sector undertakings in 2014. Total funding given to S&T institutions for research activities in the fiscal year 2014 amounts to Rs. 2,521,959,550.00. The General Treasury has funded 89.6% of this amount, which is equivalent to Rs. 2,258,852,934.00 (Fig. 3.1). Remaining 10.4%, which is equivalent to Rs. 263,106,616.00, has come from NRC, NSF, and foreign and other sources. After the General Treasury, the highest amount of research funding has come from other sources, which has offered Rs. 198,292,360.00. This is equivalent to 7.8% of the total funding received for the research activities in 2014. NRC, NSF and foreign sources have contributed Rs. 6,470,000.00, Rs. 14,558,231.00 and Rs. 43,786,025, respectively, which is equivalent to 0.25%, 0.57% and 1.73%, respectively, of the total funding given for research activities in 2014. It should be noted that a part or whole of funding that NSF and NRC disbursed among the public sector S&T institutions has come from the General Treasury. The monetary contribution of the NSF and NRC towards S&T activities in the public sector S&T institutions in 2014 is relatively smaller.

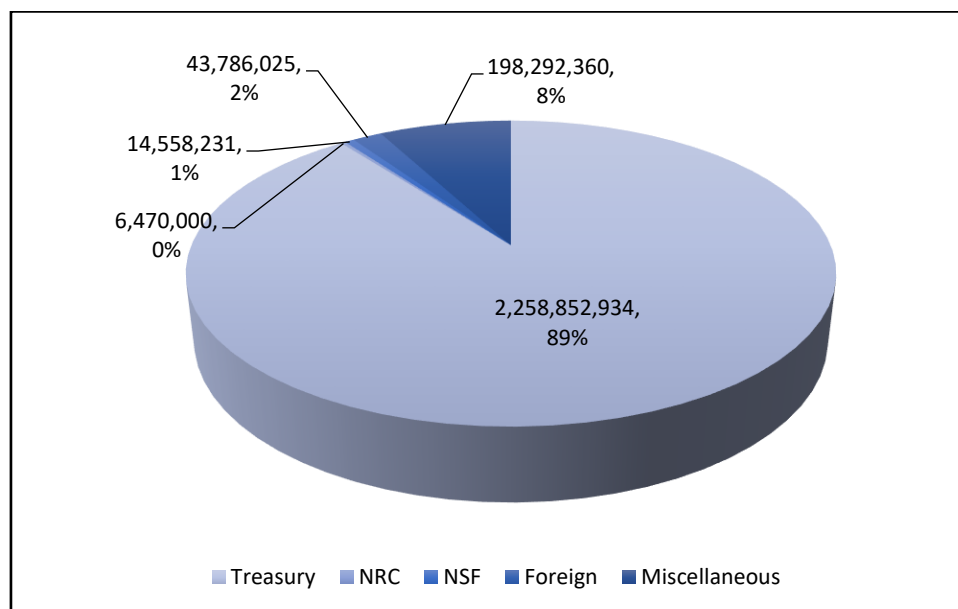


Fig. 3.1. Funding given by the General Treasury, National Research Council (NRC), National Science Foundation (NSF), foreign organizations and other sources to public sector S&T institutions for research and development activities in 2014. N.B. Data for SLINTEC not included. The amount is in Sri Lankan rupees

57.5% of the total funding, which is equivalent to Rs. 1,449,016,413.00, was given to Miscellaneous sector to do research in 2014 (Fig. 3.2). The second highest monetary allocation amounting to Rs. 519,660,000.00 has given to the Plantation sector. This is about 20.5 % of the total research funding given to the public sector S&T institutions in 2014. For research activities, a sum of Rs. 339,547,939.00 and Rs. 213,735,198.00, were allocated to the Agriculture and Engineering sectors respectively. Research funding given to the Agriculture

and Engineering sectors are equivalent to 13.5 % and 8.5% respectively, of the total funding allocated for S&T activities in 2014 (Fig. 3.2).

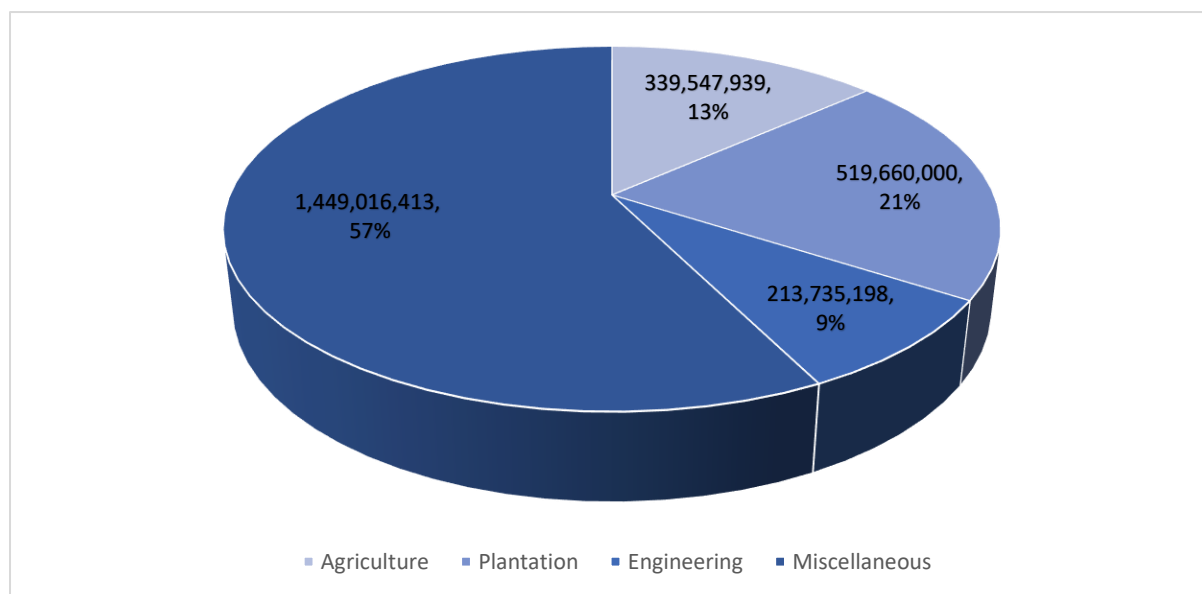


Fig. 3.2. The total amount of funding given to each sector in 2014 for research activities. N.B. Funding data for SLINTEC not included

Average research funding given per institution in the Agriculture, Plantation, Engineering and Miscellaneous sectors are Rs. 33,867,994.00, Rs. 173,220,000.00, Rs. 106,867,599.00, and Rs. 144,901,641.00, respectively (Fig. 3.3). It should be noted that funding data for SLINTEC categorized under Miscellaneous sector and CRI categorized under plantation sector was not available for these calculations.

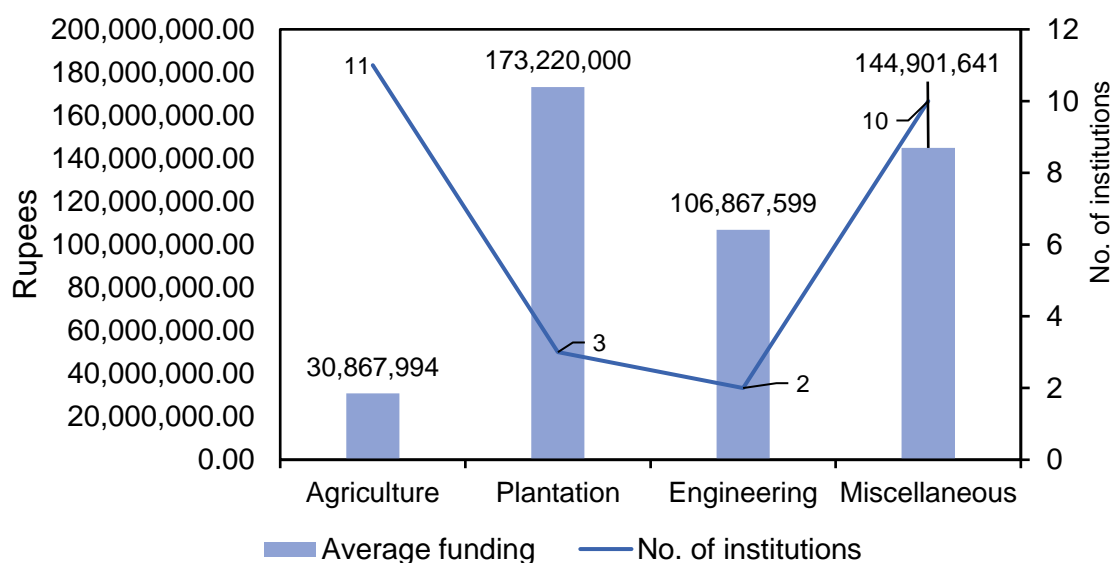


Fig. 3.3. Average funding disbursed per institution in each sector for research activities in 2014 and the number of institutions in each sector. SLINTEC is not included

Data show that the institutions in the Agriculture sector have received relatively a lowest amount of research funding in 2014.

Figure. 3.4 shows the manner in which the general treasury has disbursed public funds to different sectors to carry out research and development activities in 2014. The General Treasury has given 62.5% of its funds, which is equivalent to Rs. 1,411,461,442.00, to the Miscellaneous sector. The second highest research funding, that is Rs. 444,680,000.00, was given to the plantation sector. This amount is about 19.7% of the total funding given by the treasury for R&D activities in 2014. The Agriculture and the Engineering sectors have been given Rs. 188,976,294.00 and Rs. 213,735,198.00 respectively, which is equivalent to 8.3 % and 9.5% of total the funding disbursed among the public sector S&T institutions by the General Treasury in 2014.

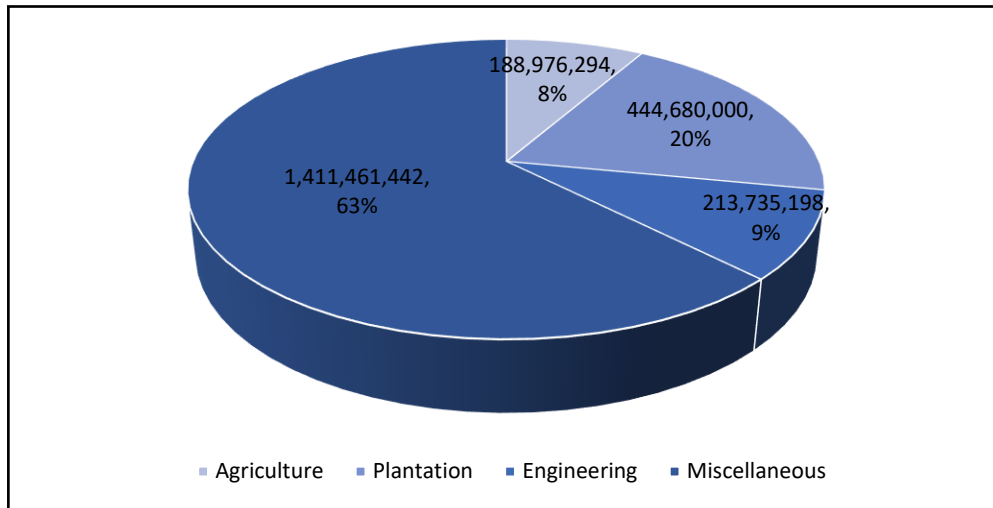


Fig. 3.4. Funding given by the General Treasury to S&T institutions in each sector in 2014. N.B. Data for SLINTEC not included. The amount is in Sri Lankan rupees.

Other than from the General Treasury, Agriculture, Plantation and Miscellaneous sectors have received research grants equivalent to Rs. 150,571,645.00, Rs. 74,980,000.00, and Rs. 37,554,971.00, respectively, from one or more of the sources such as NRC, NSF, foreign, etc. (Fig. 3.5). The amounts given to the Agriculture, Plantation and Miscellaneous sectors are equivalent to 44.3%, 14.4% and 2.6 %, respectively, of the total research funding (including that from the General Treasury) given to that particular sector in 2014.

It seems that significant share of research in the Agriculture sector has been funded by other sources (Fig. 3.5). Further, research activities in the Engineering sector in 2014 has mainly been financed by the public funds (Fig. 3.5). In addition, research activities in the Miscellaneous sector has mainly financed by the General Treasury.

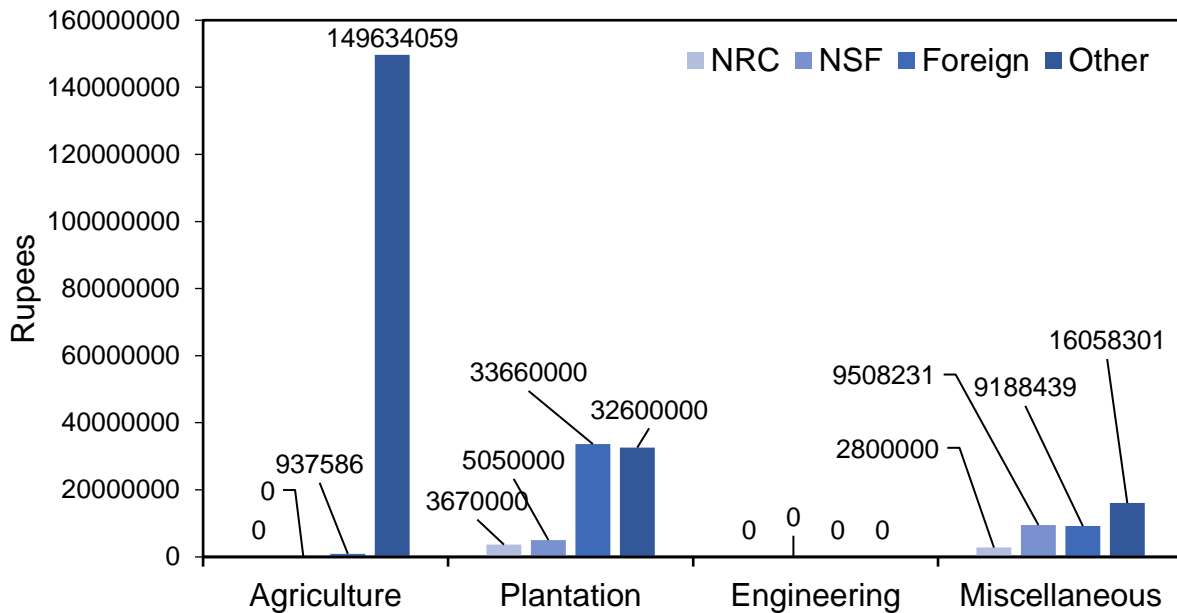


Fig. 3.5. Funding received by NRC, NSF, foreign organizations and other sources to each sector in 2014 for research and development activities in 2014. N.B. Data for SLINTEC not included. The amount is in Sri Lankan rupees.

3.2. Spending of Institutions on Research and Development

Annual spending of the Agriculture and Engineering sectors on research is higher than the full funding they have received for research activities in 2014 (Fig. 3.6). The two sectors may have covered the additional expenditure by their revenue and balance brought forward from the preceding fiscal year. The Plantation and Miscellaneous sectors have not spent the full funding they received in 2014. The main reasons that the institutions give for less spending include the delay in receipt of research funding, non-delivery of ordered equipment, chemicals, etc. before the end of the financial year, etc.

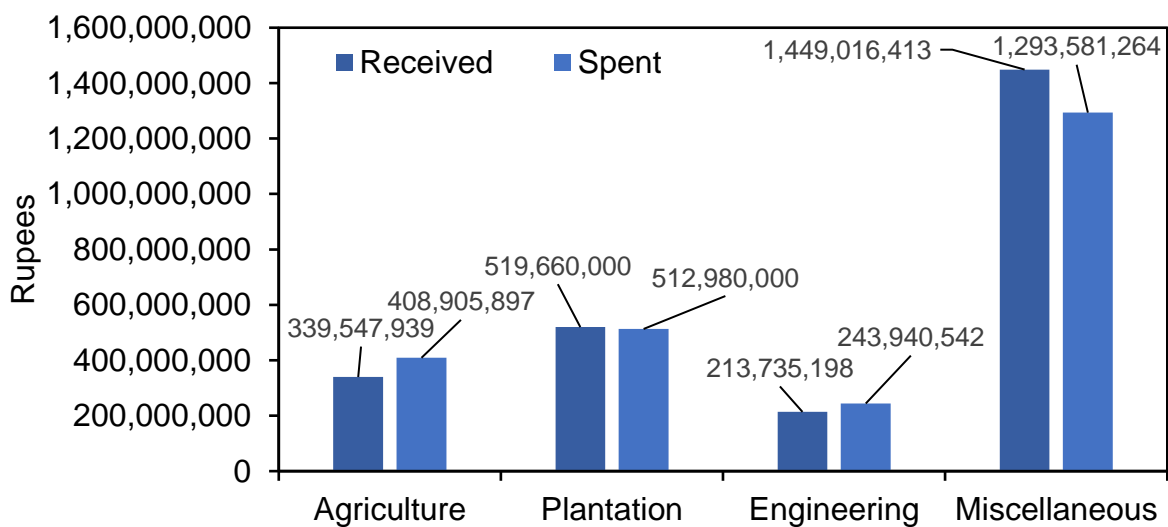


Fig. 3.6. A comparison between the funds received for and spent on research activities in 2014. N.B. SLINTEC and SRI data not included.

3.3. Funding Received for Upgrading Institutions

The general treasury has disbursed Rs. 798,258,529.00 in 2014 for upgrading S&T institutions. Upgrading includes construction of new buildings, maintenance and modification of existing buildings and machinery and equipment's, purchase of equipment, furniture, machinery, chemicals and library books and land development. Figure 3.7 shows the share that each sector received. More than 83% of funds has been given to the Plantation and Miscellaneous sectors roughly in equal shares. The engineering sector has received the least share on institutional development within the fiscal year. The general treasury has been the only financier of infrastructure development of the public sector S&T institutions in 2014.

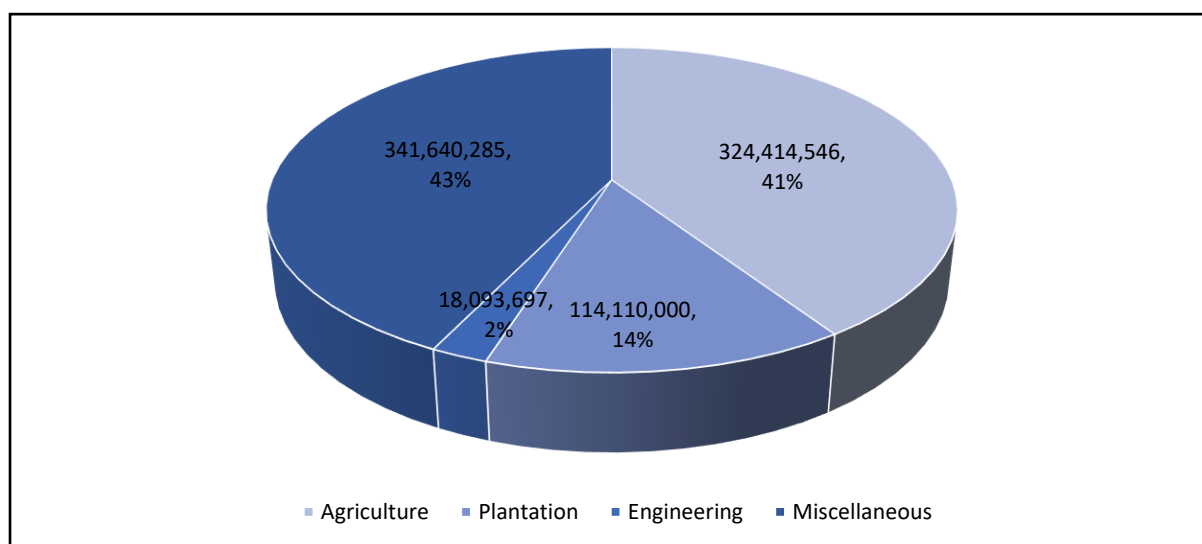


Fig. 3.7. Funding given by the General Treasury in 2014 for upgrading institutions

3.4. Funds Received for Other Scientific Activities

Table 3.1 shows the funds given for other scientific activities by the General Treasury, NSF and foreign sources. The funding, which is Rs. 59,293,552.00, was given to the agriculture sector for strengthening of the seed act and seed certification and holding workshops. About 98% of this funding has come from the General Treasury. The institution in the Miscellaneous sector received Rs. 33,485,915.00 for implementation of Soil Conservation Act, Vidu Nena Dasuna Youtube Channel, teacher training programs and activities related to accreditation. About 90% of funds for these activities has come from the General Treasury.

Table 3.1. Funds received for other scientific activities. Amount are in Sri Lankan rupees

Financier	Agriculture	Plantation	Engineering	Miscellaneous
Treasury	58,100,000	0	1,500,000	30,090,000
NSF	0	0	0	806,400
Foreign	1,193,552	0	0	2,589,515

4. Research Output

4.1. Revenue generated and number of clients served

The revenues have been generated by the institutions by rendering testing facilities, calibrating services, training, product and process certification, accreditation of labs/services, consultations, etc. Table 4.1 shows the number of clients served by each sector and the number of clients that obtained above mentioned services from each sector. Table 4.2 shows the revenue generated by each sector and by each service. The Agriculture and Plantation sectors have served the most number of clients and earned most of their revenue by providing product and process certification, training and testing facilities. The Engineering and Miscellaneous sectors have earned most of their revenue by providing testing facilities, calibration and consultancies.

The miscellaneous sector, though served a relatively less number of clients, has generated the highest amount of revenue equivalent to Rs. 271,940,169.00 (Fig. 4.1). Engineering sector has also served a relatively lesser number of clients, but has generated Rs. 32,678,217.00 as revenue. It seems that both the Miscellaneous and Engineering sectors have served corporate entities as their clients. Agriculture and Plantation sectors have served relatively a large number of clients, but have generated Rs. 8,841,147.00 and Rs. 12,464,075.00, respectively, as revenue.

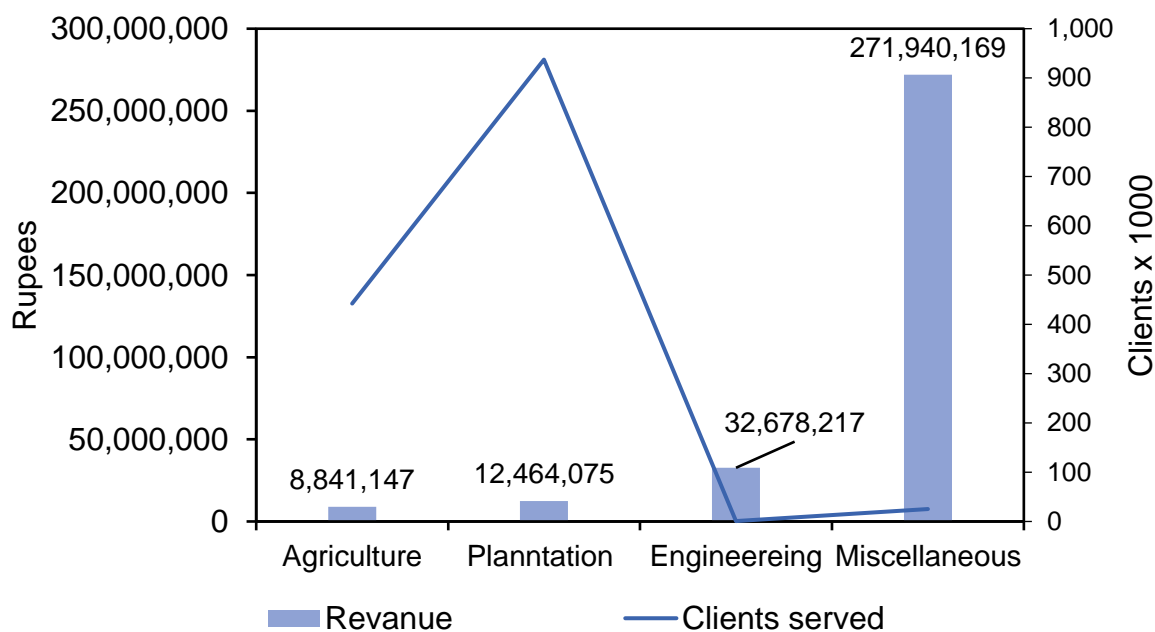


Fig. 4.1. Clients served and revenue generated by different sectors.

4.2 Processes, Technologies and Products Developed

S&T intuitions have developed a significant number of processes, technologies and products within the year 2014 (Fig. 4.2 and Table. 4.3). The Agricultural sector has developed eight processes, ten technologies and sixteen products. The Plantation sector has developed eight processes and products each. The Engineering sector has developed one process and 4 products. The Miscellaneous sector has developed 05 processes, 07 technologies and 11 products.

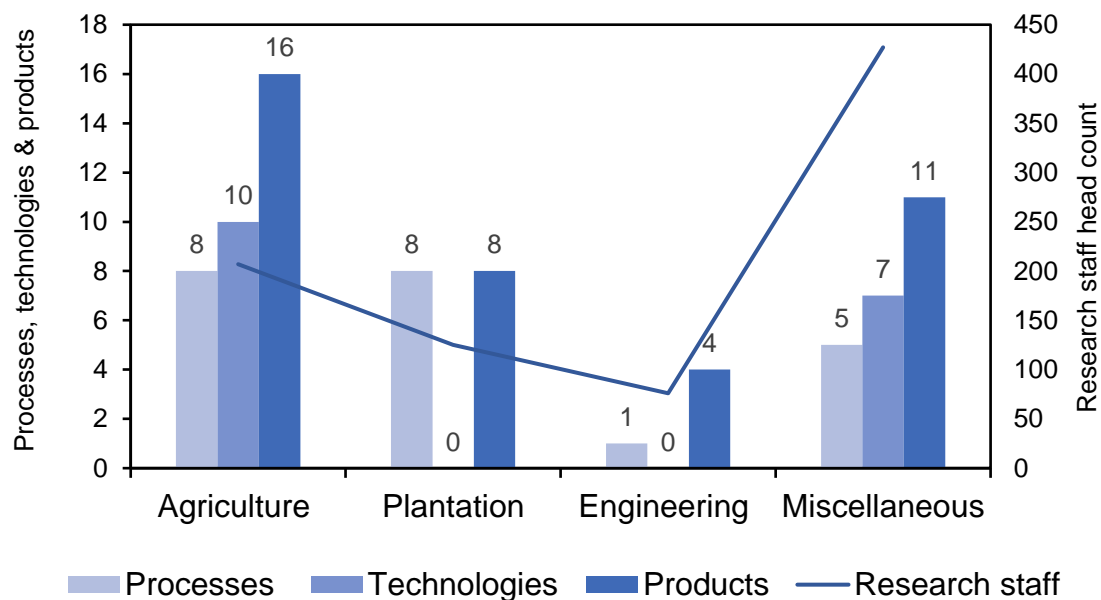


Fig. 4.2. Processes, technologies and products developed by the institutions within the year 2014

4.3 Research Publications and Patents

Table 4.3 list the number of publications made by each sector in 2014. The Agriculture sector has published 05 papers in Science Citations Index (SCI) journals and 14 papers in refereed journals. The Miscellaneous sector institutions have published 04 papers in SCI extended journals and 85 papers in refereed journals. The Agriculture, Plantation, Engineering and Miscellaneous sectors have presented 39, 53, 15 and 281, respectively, abstracts of papers at local and international symposia, conferences, etc. The Agriculture, Plantation and Miscellaneous sectors have published 22, 2 and 1 book/s and 4, 12 and 10 as chapters in books, respectively. The Miscellaneous sector has published 6 journals, while the Agriculture sector has published one.

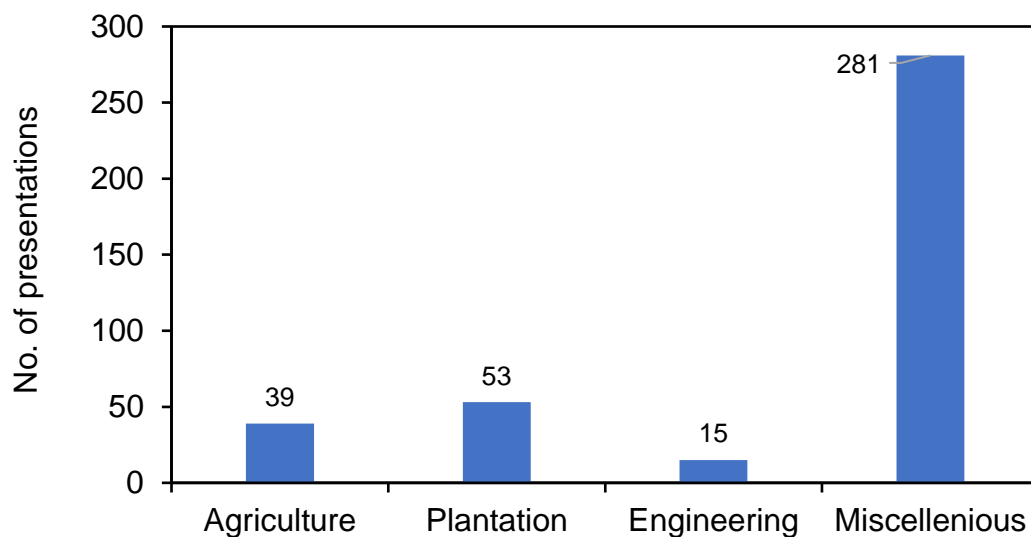


Fig. 4.3. Number of abstract of papers presented at local and international symposia, conferences, etc.

In addition to above mentioned publications, Agriculture, Plantation, Engineering and Miscellaneous sectors have published 551, 10, 33 and 234, respectively, bulletins, booklets, leaflets, etc. for dissemination of knowledge.

Agriculture, Engineering and Miscellaneous sectors have obtained 7, 1 and 29 national patents, respectively, and only the Miscellaneous sector have obtained two international patents.

The direct contribution of research publications and patents to the Sri Lankan economy is difficult to be measured quantitatively.

Table 4.1. Clients served and different services rendered by each sector.

Number of Clients Served	Agriculture	Plantation	Engineering	Miscellaneous
Testing facilities	15,181	24,318	493	20,524
Calibration	0	58	33	600
Training	32,335	6,710	154	2,262
Product/Process certification	393,490	906,140	0	55
Consultancies	46	0	95	1,588
Others	1,478	0	29	217
Total	442,530	937,226	804	25,246

Table 4.2. Revenue generated by rendering different services by each sector. Amounts are in Rupees

Revenue generated (Rs.)	Agriculture	Plantation	Engineering	Miscellaneous
Testing facilities	290,500	1,546,600	14,157,899	152,015,255
Calibration	0	0	565,980	29,000,000
Training	4,313,658	445,000	6,620,150	18,613,983
Product/Process certification	2,000,000	10,472,475	0	3,319,001
Accreditation of labs/services	0	0	0	21,910,000
Consultancies	1,036,989	0	9,038,188	11,823,337
Others	1,200,000	0	2,296,000	35,258,594
Total	8,841,147	12,464,075	32,678,217	271,940,169

Table. 4.3. Research output of S&T institutions.

i) New Products/Process/Technologies Developed		Agriculture	Plantation	Engineering	Miscellaneous
Processes		8	8	1	5
Technologies		10	0	0	7
Products		16	8	4	11
ii) Number of Publications				0	
In SCI journals		5	0	0	0
In SCI extended journals		0	0	0	4
In refereed journals		13	0	1	85
Abstracts of Papers presented at Conferences /Symposiums, etc.		39	53	15	281
As monographs		0	0	0	0
As books		22	2	0	1
As chapters in books		4	12	0	10
Journals published by the institute		1	0	0	6
Others (Bulletins, leaflets, etc.)		551	10	33	234
iii) National/International patents					
Number of patents	National	7	0	1	29
	International	0	0	0	2

5. Issues Identified

Senior officers of the NASTEC visited institutions of different sectors and reviewed their S&T status. Listed following are some of the common issues identified based on the analysis of data collated via the questionnaire and the discussions had with institutions' staff members and top officials.

5.1 Agriculture and Plantation sectors

- Shortage of scientific staff. Delay in new recruitments and filling of vacant cadre positions.
- Delay in receipt of chemicals once an order is placed.
- Most of the experienced technical officers (TOs) have retired or about to retire soon.
- Newly recruited TOs are not competent to maintain and repair instruments.
- Dearth of highly sophisticated state of art instruments, which are very costly.
- Some institutions have a lack of infrastructure facilities such as spacious buildings, intercom facilities, internet, computers, vehicles, etc.
- Lack of labour in the areas of testing seeds, sampling allocation, etc. during peak harvest season.
- Some regulations are outdated. Reimbursed transportation (e.g. bus fare), food, accommodation, etc. cost are lower than their current costs.
- Tariffs for testing of soil, seeds, etc. haven't been revised for a long time. As a result, the testing facilities in some institutions are currently making operational losses.

5.2 Engineering and Miscellaneous sectors

- There are a significant number of vacant cadre positions for scientific staff.
- Lack of training given to scientific staff in the Engineering sector.
- The Miscellaneous sector hasn't spent all of its research funding in 2014. Reasons the institutions site for this include delay in receipt of funds so that they do not have sufficient time to purchase equipment's or consumables and delay in receipt of ordered chemicals, equipment's, etc. before the end of the fiscal year.

6. Recommendations

- i. It would be better to fill vacant cadre positions of scientific staff. Special attention should be given to the Agriculture sector since the gap between the number of recruitments and retirements plus resignations is relatively smaller. Increasing the research to other staff ratio in S&T institutions may enhance the S&T status of the institutions as well as of the country.
- ii. The Agriculture sector received the least amount of research funding per intuition in 2014. This sector contributes a significant proportion to the Sri Lankan economy. Therefore, it would be better to allocate more government funding to the Agriculture sector to promote its S&T status.
- iii. Outdated payment systems and tariff for testing facilities in the Agriculture and Plantation sectors could be revised to boost the revenue generated by the two sectors and prevent some operational losses.
- iv. It would be better those S&T institutions having a long term plan to maintain a second tier of well-trained technical officers (TOs) so that the retirement of TOs will not create a vacuum in the areas of repairing and proper maintenance of instruments. It should also be noted that training the scientific staff is vital factor in improving the S&T status of the intuitions and the country.
- v. Better to give more postgraduate opportunities and training to scientific staff, especially those in the Engineering and Miscellaneous sectors. Research staff in the Engineering sector may be encourage to peruse doctoral studies.
- vi. Few public sector intuitions were reluctant or declined to provide information to the NASTEC. The Medical Research Institute (MRI) did not provide any information to the NASTEC at all. The SLINTEC and CRI did not provided their financial data. The commission is of the opinion that the public sector S&T institutions are obliged, as per the powers vested in the commission by the Science and Technology Development Act No. 11 of 1994, to make their S&T related data available to the NASTEC. Therefore, it may be better to have a ministry level awareness program to address this issue.
- vii. S&T activities in the national universities in Sri Lanka make a significant contribution to the S&T status of the country. However, dearth of staff and budgetary constraints have left the commission in a difficult situation to undertake such a study not only on national universities but also on private sector undertakings.

Summary of S&T Status of Sri Lanka

National Science and Technology Commission (NASTEC) identified 28 public sector institutions and reviewed their science and technology (S&T) status for the fiscal year 2014. The institutions were categorized into four sectors as Agriculture, Plantation, Engineering and Miscellaneous and each sector has 11, 4, 2 and 11, institutions respectively. Human resources, finances and the productivity (output) of each sector were assessed on the basis of a questionnaire given to the institutions. The Medical Research Institute (MRI), did not provide any information to the NASTEC at all. The Sri Lanka Institute of Nano Technology (SLINTEC) didn't provide the financial data.

This study shows that most institutions have vacant cadre positions for scientific staff (research and research supporting staff). The Agriculture, Plantation, Engineering and Miscellaneous sectors have Research to other staff ratios of 1:6, 1:8, 1:5 and 2:7, respectively. Though new recruitments of research staff were made in 2014, this is not enough to fill the existing vacancies and the vacancies created by the retirement and resignation of staff in 2014. Staff in the Agriculture sector have attended the most number of training programs that include workshop, seminar, conferences, etc. However, institutions in any sectors haven't offered training programs for their technical staff within the year.

A total sum of Rs. 2,521,959,550.00 was allocated to research activities of the public sector institutions in 2014. The General Treasury has funded 89.6% of this amount, which is equivalent to Rs. 2,258,852,934.00. Remaining 10.4%, which is equivalent to Rs. 263,106,616.00, has come from NRC, NSF and foreign and other sources. NRC, NSF and foreign sources have contributed Rs. 6,470,000.00, Rs. 14,558,231.00 and Rs. 43,786,025, respectively. Rs. 198,292,360.00 has been received from other sources as research funding. 57.5% of total funding disbursed among the S&T institution in 2014, which is equivalent to Rs. 1,449,016,413.00, was given to the Miscellaneous sector. A sum of Rs. 339,547,939.00, Rs. 519,660,000.00 and Rs. 213,735,198.00, respectively, were allocated to the Agriculture, Plantation and Engineering sectors, respectively as research funding. Average research funding given per institution in the Agriculture, Plantation, Engineering and Miscellaneous sectors are Rs. 33,867,994.00, Rs. 173,220,000.00, Rs. 106,867,599.00, and Rs. 144,901,641.00, respectively. Average research funding received by institutions in the Agriculture sector is the lowest. It is more than three times lower than the second lowest average research fund receiver, the plantation sector. Funding data for the SLINTEC categorized under Miscellaneous sector and therefore were not included in the above calculations.

In addition to research financing, the General Treasury has disbursed Rs. 798,258,529.00 for upgrading S&T institutions in 2014. This includes construction of new buildings, maintenance and modification of existing buildings, machinery and instruments, purchase of equipment, furniture, machinery, chemicals and library books and land development. More than 83% of funds have been given to the Plantation and Miscellaneous sectors roughly in equal shares. The Engineering sector has received the least share which amounts to Rs. 18,093,692.00.

The Agriculture sector received Rs.59,293,552.00 for strengthening the seed Act and seed certification and holding workshops. About 98% of this funding has come from the General Treasury. Institutions in the Miscellaneous sector received Rs. 33,485,915.00 for implementation of the Soil Conservation Act, Vidu Nena Dasuna YouTube Channel, teacher training programs and activities related to accreditation. About 90% of this funds came from the General Treasury.

In 2014, institutions generated revenue by rendering testing facilities, calibrating services, training, product and process certification, accreditation of labs/services, consultations, etc. The Agriculture and Plantation sectors earned most of their revenue by providing product and process certification, training and testing facilities. Engineering and miscellaneous sectors earned most of their revenue by providing testing facilities, calibration and consultancies. The Miscellaneous sector, though served a relatively less number of clients, has generated the highest amount of revenue equivalent to Rs. 271,940,169.00. Engineering sector has also served a relatively lesser number of clients, but has earned Rs. 32,678,217.00 as revenue. It seems that both the Miscellaneous and Engineering sectors have served corporate entities as their clients. The Agriculture and Plantation sectors have served a relatively larger number of clients, but have earned Rs. 8,841,147.00 and Rs. 12,464,075.00, respectively, as revenue.

Institutes have developed a significant number of processes, technologies and products within the year 2014. The Agriculture sector has developed 08 processes, 10 technologies and 16 products. The Plantation sector has developed 08 processes and products each. The Engineering sector has developed one process and 4 products. The Miscellaneous sector has developed 05 processes, 07 technologies and 11 products.

The Agriculture sector have published 05 papers in Science Citations Index (SCI) journals and 14 papers in refereed journals. The Miscellaneous sector has published 04 papers in SCI extended journals and 85 papers in refereed journals. The Agriculture, Plantation, Engineering and Miscellaneous sectors have presented 39, 53, 15 and 281, respectively, abstracts of papers at local and international symposia, conferences, etc. The Agriculture, Plantation and Miscellaneous sectors published 22, 2 and 1 book/s and 4, 12 and 10, respectively, as chapters in books. The Miscellaneous sector published 6 journals, while the Agriculture sector published one.

As for the usage of science and technology in the public sector S&T institutions, most institutions have basic instruments and equipment's to fulfill their day to day research activities. However, some institutions, especially those in the Agriculture and Plantation sectors have a dearth of even basic infrastructure facilities such as spacious buildings, computers, intercom facilities, internet, etc. Further, the intuitions have a shortage of highly sophisticated state of the art instrument facilities, which are very costly and need a huge capital investment to purchase them.

It would be better to fill vacant cadre positions for research staff to improve the S&T status of the country. In this context, special attention should be given to the Agriculture and Plantation sectors. The Agriculture sector has a significant contribution to the Sri Lankan economy. Therefore, may be better to allocate more research funding to the Agriculture sector to ensure

food security in Sri Lanka. Outdated payment systems and tariff for testing facilities in the Agriculture and Plantation sectors should be revised to prevent or reduce operational losses incurred by testing of soil, seeds, etc.

It may be better if more postgraduate opportunities and training could be given to research staff, specially who are in the Engineering sector. Institutions should have a long term plan to maintain a second tier of well-trained TOs so that the retirement of TOs will not create a vacuum in repairing and proper maintenance of instruments.

A ministry level awareness program may be appropriate to educate the public sector S&T institutions of their obligation to making HR, financial and output, etc. data available to the NASETC. However, data which become essentially confidential as a result of formal agreements that the institutions may have entered into with other organizations are not obliged to provide to the NASTEC.

S&T activities in the national universities in Sri Lanka make a significant contribution to the S&T status of the country. In order to evaluate the contribution of the national universities and private sector undertakings to the S&T status of the country, the NASTEC will require more staff and infrastructure facilities.