

**Presidential Address**  
**RESEARCH IN CHEMICAL SCIENCES: THE SRI LANKAN SCENARIO**

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The Presidential year 2005/2006 was a significant and memorable one for the Institute of Chemistry. On the 25<sup>th</sup> January, having successfully achieved the goals set for the year, we celebrated our first anniversary at the new headquarters on a happy note. We had the highest ever enrolment of students for both the Graduateship in Chemistry Programme and the Diploma in Laboratory Technology Course. The Institute received the highest ever government grant for the activities of the Institute of Chemistry. We are extremely pleased and thankful to the Government for such a positive response to our work.

The College of Chemical Sciences, the educational arm of the Institute of Chemistry, was shifted to the headquarters during this year. The College is now making preparations to commence the hitherto non-available research component of the Graduateship Programme. This is made possible with the availability now of fully furnished laboratories and the well equipped Instrument Centre in the new building. We therefore taking this new activity into consideration, decided to dedicate the activities of the Presidential year 2005/2006 to highlight the importance of research and chose the theme "Research in Chemical Sciences: Outlook and Prospects for the Future". We hope that the activities under the theme will help the College to commence its research activities with a vision and with a well-coordinated effort, focusing on the future. Under the theme, three successful, well-attended seminars entitled, "Search for Drugs", "Light: Harvesting, Sensing and as a Depollutant" and "Gene Technology in Molecular Medicine and Forensic Science" were conducted during the year. Resource persons for these seminars were our own researchers actively involved in the respective fields. The final seminar on the theme would be held during the Annual Sessions with the participation of seven eminent scientists, exposing the cutting edge research in Chemical Sciences conducted in the rest of the world. Our hope is that these seminars will give a foundation and proper atmosphere to the College to embark on new areas of research benefiting the country. During the annual sessions this year, recognizing the importance of the industrial sector, we have organized a specialized seminar on "Food Safety" for two days with an international expert. This seminar will, I know, benefit our food and beverage industry.

In keeping with the theme of the year, I have chosen "Research in Chemical Sciences: The Sri Lankan Scenario" as the title of my Presidential Address. I endeavour to indulge in the past and the present research activities in Chemical Sciences in Sri Lanka and project the scenario for the future. This presentation, I hope would help all of us to analyze our

predicament in research and take remedial measures, so that we could look forward at least to a position on par with our regional neighbours in research in chemical sciences in the near future.

**Past Scenario:**

While perusing through the available references to the past research activities in Sri Lanka my task was made easier when I discovered a very relevant Presidential Address given by Professor MUS Sultanbawa way back in 1959 entitled, "Chemical Research in Teaching Institutes in Ceylon 1900-1950". This address will form the backdrop to the history part of my presentation. It gives a rare insight into the research activities in Ceylon at the turn of the twentieth century. Recognizing that we were still a British Colony the major contributors to the research in Chemical Sciences during this period were the British scientists. Some of them came to Sri Lanka to teach at Royal College, Colombo. The two higher educational Institutes in Sri Lanka at the time were the Ceylon Medical College (established in 1870) where premedical students were prepared for London University examinations and Ceylon Technical College (established in 1893) where technical training was given to Ceylonese students. There were no universities at the time. The British Scientists who were sent to Sri Lanka during the early period were appointed as Professor of Chemistry and Physics at the two Institutes. Among them there were three prominent scientists. Professor K.C. Browning was appointed as the first Professor of Chemistry and Physics at the Ceylon Medical College and the Ceylon Technical College in 1904 and held the position until 1906. He was also the Public Analyst during this period and was appointed as the first Head of the newly established Government Analyst's Department in 1907. In the short period he was teaching, he produced a book on "Practical Inorganic Chemistry". Professor A.F. Joseph held the post of Professor of Chemistry and Physics at the Ceylon Medical and Technical Colleges from 1908-1916. In 1910 he revised Browning's "Practical Inorganic Chemistry" and published it as "Practical Chemistry" by K.C. Browning and A.F. Joseph. Mr. W.N. Rae was the acting Professor of Chemistry and Physics at the Ceylon Medical College and Government Technical School (change of name in 1910) from 1916 to 1920. When the University College was established in 1922, Mr. Rae was appointed as its acting Professor of Chemistry and made Professor of Chemistry in 1923. He served in this capacity until his retirement in 1933. The University College also prepared students for the external degree examination of the London University. The three Professors maintained a steady stream of

research and through their work, made an important contribution to the country. Their research programmes covered both pure and applied research in Chemical Sciences. The research areas covered by the three scientists with their colleagues can be summarized as follows.

1. Alcohol estimation in the tropics using specific gravity and refractive index measurement using the methods and devices they have developed. They also studied the method of collection of juice and analysis of fresh juice, fermented juice (toddy) and distilled liquor (arrack). Professor K.C. Browning with C.T. Symons published four papers on the topic in *J.Chem.Ind., Trans.Far.Soc., Proc.Chem. Soc.*, from 1914 to 1917.
2. Analysis of ghees from buffalo and cow butter using refractive index measurements. Prof. Browning published the work with Parthasarathy in *J.Soc.Chem.Ind.*, in 1917.
3. Determination of trace amounts of Hg salts for toxicological purposes using spectroscopy. Prof. Browning published the findings in *J.Chem.Soc.* in 1917.
4. Formic acid decomposition and estimation. A.F. Joseph, *J.Soc.Chem.Ind.* 1910
5. Kinetics of bromine addition. Prof. Joseph published four papers in the Journals, *Z. Physic.Chem., Proc.Chem.Soc.*, and *J.Chem.Soc.*, and a paper in *J.Chem.Soc.*, with Jinendradasa during the period 1910 to 1915.
6. Alcoholometry. Prof. Joseph published two papers with Mr. W.N. Rae in *J.Chem.Soc.Ind.* in 1913 and 1914.
7. Analysis of Ceylon arrack. Prof. W.N. Rae and C.T. Symons in *J.Chem.Soc.Ind.*, 1923.
8. Physical and chemical constants of animal fats. (Ceylon bear, kabaragoya, leopard, sambhur, spotted deer, peacock and pig). W.N. Rae, two papers in *Analyst* in 1922-1924.
9. Seasonal variations in the composition of the latex of *Hevea brasiliensis*. W.N. Rae, one paper in *Analyst*, 1928.
10. Action of  $Cl_2$  and  $Br_2$  on alkali iodides. W.N. Rae, three papers in *J.Chem.Soc.* and *J.Amer.Chem.Soc.* from 1915 to 1923.
11. Research on hydrates. W.N. Rae, three papers in *J.Chem.Soc.*, 1916 and 1931.
12. Polyhalides of caesium. W.N. Rae, two papers in *J.Phys.Chem.*, and *J.Chem.Soc.*, 1931
13. Conductometric titrations. W.N. Rae, two papers in *J.Chem.Soc.*, 1931.

Professors Browning, Joseph and Rae have actively pursued research during the period 1904 to 1933 and published a total of 30 papers in International Journals. During this period the number of students enrolled was small and there were no local examinations. These fac-

-tors gave them ample time during vacations to engage in research without hindrance.

Professor J.P.C. Chandrasena was appointed to the Chair of Chemistry in 1933 on the retirement of Professor W.N. Rae. He was one of the first persons to join the newly inaugurated University College in 1922 as a lecturer. His main research interest was in Economic and Medicinal plants of Ceylon and he pioneered the chemical investigation on medicinal plants in Sri Lanka. He collected data on the Ceylon and Indian medicinal plants and authored a valuable book titled, "The Chemistry and Pharmacology of Ceylon and Indian Medicinal Plants". He was unable to publish the book during his life time due to his sudden death in 1934 and the book was published in 1935 by his wife. He was also the author of five research papers in international journals on the following topics.

1. Chemistry of the various products of the coconut palm. J.P.C. Chandrasena, two papers in *Biochem.J.*, 1930 and *J.Chem.Soc.*, 1933.
2. Methyl furfuraldehyde oxide as a by product in the preparation of hydroxymethyl furfuraldehyde. J.P.C. Chandrasena, one paper in *J.Chem.Soc.*, 1930.
3. Isolation of atisine from tubers of *Aconitum heterophyllum*. J.P.C. Chandrasena, one paper, *J.Chem.Soc.*, 1933.
4. Essential oil of *Canarium Zeylanicum*. J.P.C. Chandrasena and Lourensz, one paper in *J.Chem.Soc.Ind.*, 1933.

It was said about Professor Chandrasena, that he was more interested in the work he was doing than the publication of his results.

Professor A. Kandiah was appointed to the Chair in Chemistry in 1934 after the sudden death of Professor Chandrasena. He joined the University College in 1933 as a lecturer in Physical Chemistry and then took over the teaching of Organic Chemistry in 1934. During this period, the University began to expand rapidly. The preparation for the establishment of the University of Ceylon was underway and he was involved in the project. The time available for him to carry out research was limited. Although he managed some research work in Organic Chemistry with the limited facilities available, research work did not reach the stage of publication. However he laid the foundation for the future development of the Department of Chemistry of the newly established University of Ceylon in 1942.

Professor E.L. Fonseka was appointed as the Professor of Chemistry in 1951. He worked with Professor Chandrasena to determine the organic constituents in local plants: From *Coscinium fenestratum* (Sinh. venivel gate) only barberine was isolated; from *Piper betle* oil (Eng. betel, Sinh. bulath) only the presence of phenolic compounds were confirmed; work on the volatile constituents in coriander and *Aegle mermelos* (Sinh. beli) leaves gave no publishable results.

Chemical Research at Ceylon Medical College was commenced in 1939 with the appointment of Dr. A.A. Hoover as a lecturer in Biochemistry. After Dr. Hoover left to join the Medical Research Institute, Dr. N.G. Baptist continued the chemical research at the Medical College. A summary of their research is given below.

1. The mineral analysis of some local yam. A.A. Hoover, one paper in *Trop. Agri.*, 1941.
2. Influence of pH and salts on the solubility of calcium oxalate. A. A. Hoover and G.S. Wijesinghe, one paper, *Nature*, 1945.
3. Oxalate content of some leafy vegetables. A.A. Hoover and M.C. Karunairatnam, one paper, *Biochem. J.*, 1945.
4. Amino acid analysis of vegetable proteins. N.G. Baptist, 2 papers, *British J. Nutrition*, 1954.

After about 1933, a decline in research activities at the University of Ceylon was observed. This was mainly due to the gradual increase in the number of students and the establishment of the University of Ceylon in 1942. The University now had to conduct all its own examinations.

During this period two other important events benefiting the scientists in Ceylon took place. These were the establishment of the Chemical Society of Ceylon in 1941 and the Ceylon Association for the Advancement of Science in 1944. Chemists were involved in the establishment of both the societies. These societies provided fora for the scientists to interact and to conduct lectures for the benefit of the members on subjects of topical interest by local and foreign scientists. The two societies also provided opportunities for the scientists to present original research findings at the Annual Sessions and the outstanding research contributions were recognized and awards were made available to the researchers.

In 1971 the Chemical Society was converted to a full professional body and was transformed into the Institute of Chemistry, Ceylon incorporated by an act of Parliament in 1972. The Institute gives several awards for outstanding research contributions in Chemistry. They are, the Institute of Chemistry Gold Medal, Chandrasena Memorial Award, Devanathan Memorial Award, three Kandiah Memorial Awards and Sultanbawa Memorial Award, named after eminent chemists produced by the University of Ceylon.

#### **Present Scenario:**

In the early 1960s, with the establishment of the University of Ceylon at Peradeniya with residential facilities, the chemical research base was shifted to Peradeniya. Professor M.U.S. Sultanbawa was the Professor of Chemistry at both Colombo and Peradeniya, until in 1967, the University was separated into two universities, the University of Colombo and

the University of Peradeniya. Professor Sultanbawa established a centre of excellence in Natural Products Research at Peradeniya. The period that followed saw the majority of research publications coming from the University of Peradeniya. Since then the number of Universities has increased to 14 up-to-date and almost all the universities contribute to research in chemical sciences. In the 1980s, the establishment of the Institute of Fundamental Studies in Kandy enhanced the research capability and output in basic research.

#### **Contributors to Research:**

Major contributors to research in chemical sciences, at present are the Universities; the Research Institutes: namely the Industrial Technology Institute (former CISIR) and the Institute of Fundamental Studies; the Government and Crop Research Institutes: such as the Medical Research Institute, Coconut Research Institute, Rubber Research Institute and Tea Research Institute; private sector industries and some government and private hospitals. These institutes publish their research findings nationally and internationally.

Taking into consideration the current research activities in Sri Lanka, I wish to present an analysis based on the publications in national and international journals from 2000 to 2006. The research communications presented at the annual sessions of the Institute of Chemistry and the Sri Lanka Association for the Advancement of Science from 2000 to 2006 are also included. I also wish to analyze the research outcome in the form of postgraduate degrees awarded by the universities.

#### **Current Research Activities:**

The current research activities in chemical sciences in Sri Lanka can be broadly categorized into following areas.

1. **Natural Products Chemistry:** Phytochemical studies; isolation and structural determination of active compounds guided by traditional knowledge, and now by bioassay guided prior screening, improvement of extraction procedures.
2. **Medicinal Chemistry:** Synthesis of biologically active secondary metabolites, mechanism of action of drugs, study of biologically active compounds to unravel the mechanism of action.
3. **Biochemistry:** Studies on analysis of the composition and content of carotenoids, and also the bio-accessibility, bioavailability, bioconversion studies of carotenoids in local vegetables and fruits; studies on bitter principle, flabelliferins and bioactivity of palmyrah fruit pulp; medicinal and therapeutic value of medicinal plants; studies on micro-nutrients in Sri Lankan diet.

- Materials Chemistry: Studies on conducting polymers, semiconductors, solid electrolytes and catalysts.
- Analytical Chemistry: Development of new analytical methods, base line studies on environment and environment modeling studies.
- Photochemistry: Synthesis of new photoactive compounds, development of photochemical molecular sensors, solar energy conversion studies,  $N_2$  and  $CO_2$  fixation and other chemical processes driven by photons.
- Electrochemistry: Electrochemical sensors, development of solid electrochemical cells, solid electrolytes and solar cells.
- Theoretical Chemistry: Computer aided drug design, molecular simulation and modeling and structure-activity relationships.
- Molecular methods: For detection of diseases and molecular markers for cash crops and fish.

#### Local Publications:

##### *Institute of Chemistry, Ceylon:*

Research presentations at the Annual Sessions of the Institute of Chemistry are a good indicator to observe the trends in research in Chemical Sciences in Sri Lanka. The data collected from 2000-2006 are presented in Figure 1.

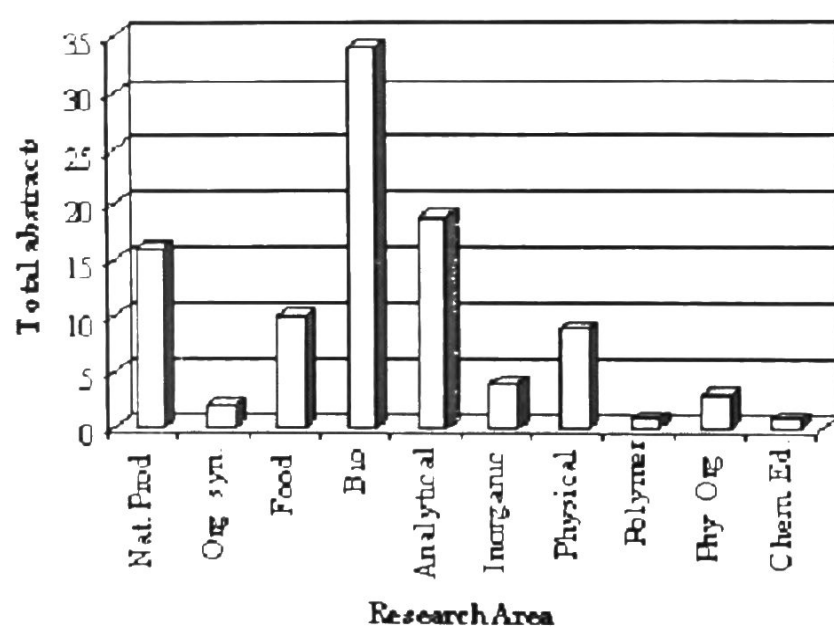


Figure 1: I.Chem.C. Abstracts 2000-2006

During the period under study, the highest number of presentations was from Biochemistry, amounting to 34% of the total presentations. Analytical Chemistry was second with 19%, Natural Products was third with 16% and Food Chemistry was fourth with 10%. In all the other areas, Organic Synthesis, Inorganic Chemistry, Physical Chemistry, Polymer Chemistry, Physical Organic Chemistry and Chemical Education presentations were below 10%.

It is also interesting to note that awards given by the Institute of Chemistry for the excellence in research during the period 2000 to 2006 are in the order, Biochemistry (10), Natural Products Chemistry (09), Food Chemistry (01) and Physical Organic Chemistry (01). This shows that research in chemical sciences

in Sri Lanka is mainly concentrated in the fields of Biochemistry and Natural Products Chemistry.

##### *Sri Lanka Association for the Advancement of Science (SLAAS):*

Research presentations in chemical sciences at annual sessions of SLAAS during the period 2000-2006 are given against the total presentations in Figure 2.

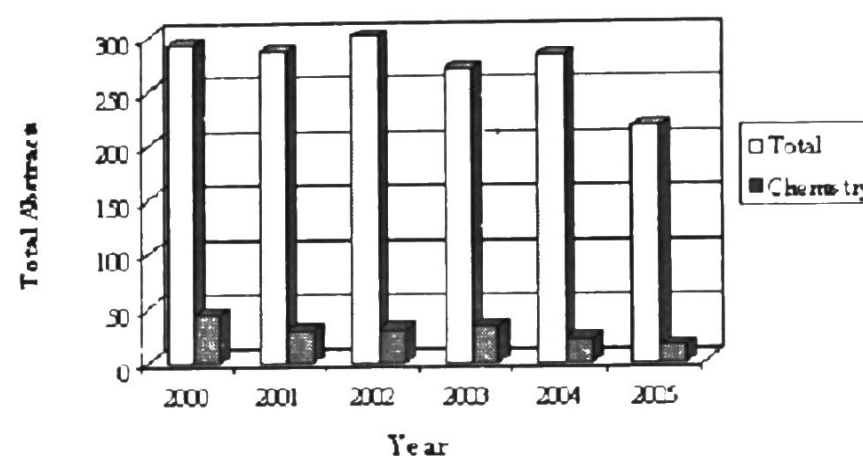


Figure 2: SLAAS Abstracts 2000-2005

The number of presentations in chemical sciences remains almost static, fluctuating around 13% to 10%. The overall average of publications during the study period is 10% of the total.

##### *Study by National Science Foundation (NSF):*

NSF in a publication (R.M.W Amaradasa, R.P Pathirage and A. Tennakoon) in 2003 gives a summary of local publications (772) in 2000, taking into consideration most of the peer reviewed publications in Sri Lanka (Figure 3).

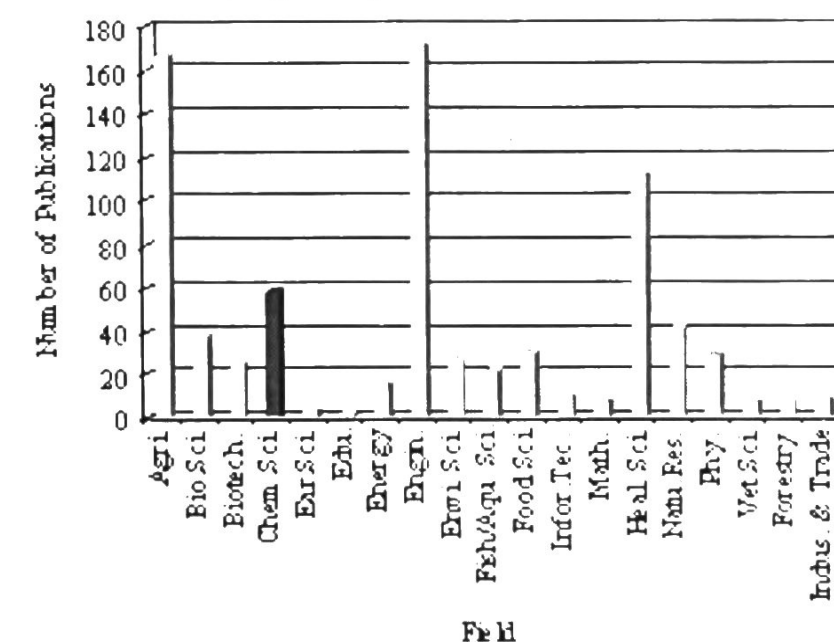


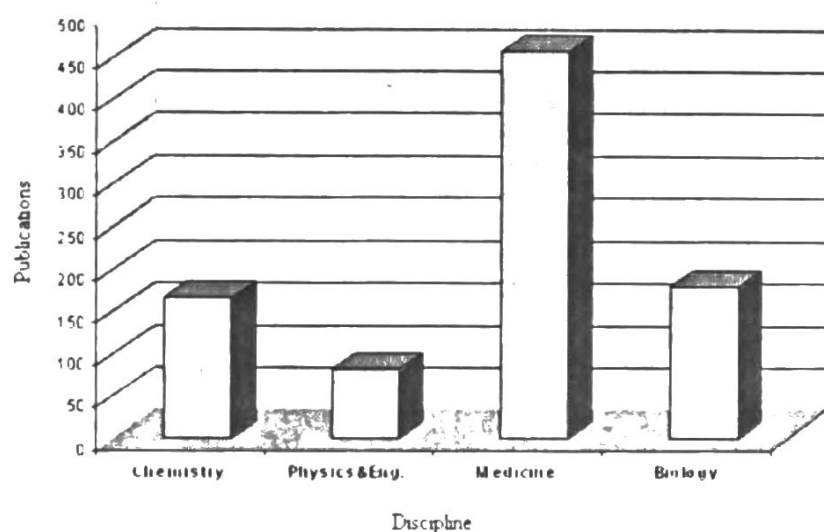
Figure 3: Local publication 2000

According to this study, the highest number of publications (172) is from Engineering followed by Agriculture (162) and Health Sciences (111). Chemical Sciences occupy a moderate position with 58 publications. This shows that the research has been concentrated mainly in economically important areas of agriculture and the services sectors of engineering and medicine, where the government has given assistance since colonial times. Except education these three areas generally represent the government priority areas aimed at giving a better quality of life to the people in Sri Lanka.

## International Publications:

### Science Citation Index (SCI):

Sri Lankan scientists' contribution to the world scientific knowledge is indexed in the Science Citation Index. Figure 4 gives the total number of publications originated from Sri Lanka appearing in the Science Citation Index for several disciplines from 2000 to 2006.

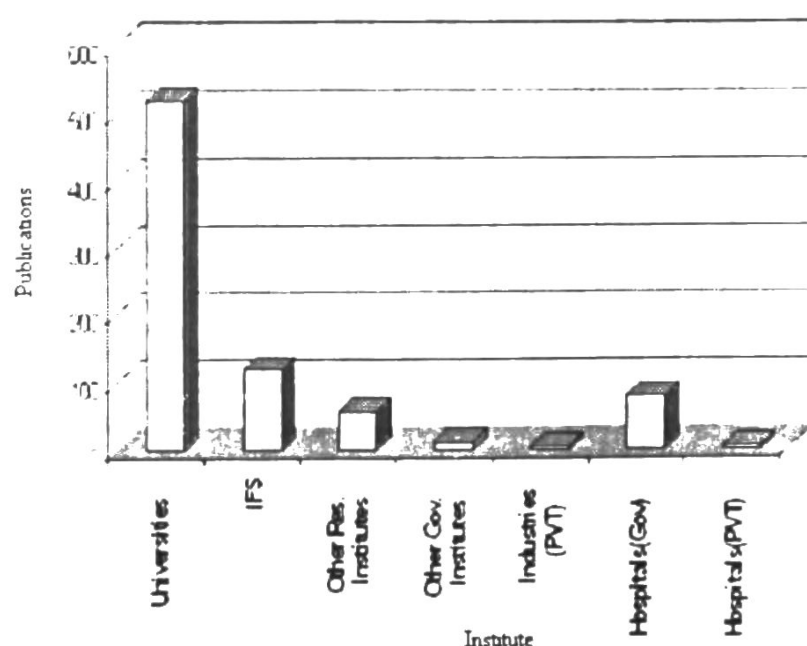


Source: Science Citation Index

**Figure 4 : Publications by Discipline, Sri Lanka 2000-2006**

The highest number of publications is in Medicine (50%) followed by Biology and then closely followed by Chemistry. Publications from physics and engineering recorded the lowest. The percent of chemical sciences publications is about 18% of the total. Medicine ranked number one in its publications in SCI.

Figure 5 indicates the publications recorded in the Science Citation Index, originated from different Institutes in Sri Lanka for the period 2000 to 2006.

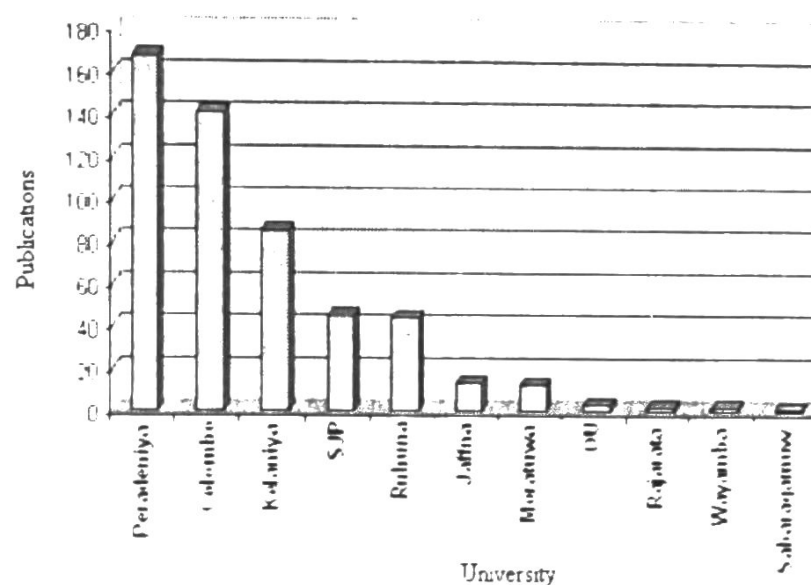


Source: Science citation index

**Figure 5: Publications by Institute 2000-2006**

The majority of publications (70%) are from the universities. The Institute of Fundamental Studies (IFS) follows (20%) for obvious reasons, as the numbers involved in research at IFS are much less compared to the universities. Other research institutes and government hospitals contribute about 10% each. Contributions to SCI from other government institutes, industries and private hospitals are not very significant.

Figure 6 gives the output of publications from 11 universities in Sri Lanka recorded in the SCI during the period 2000 to 2006.



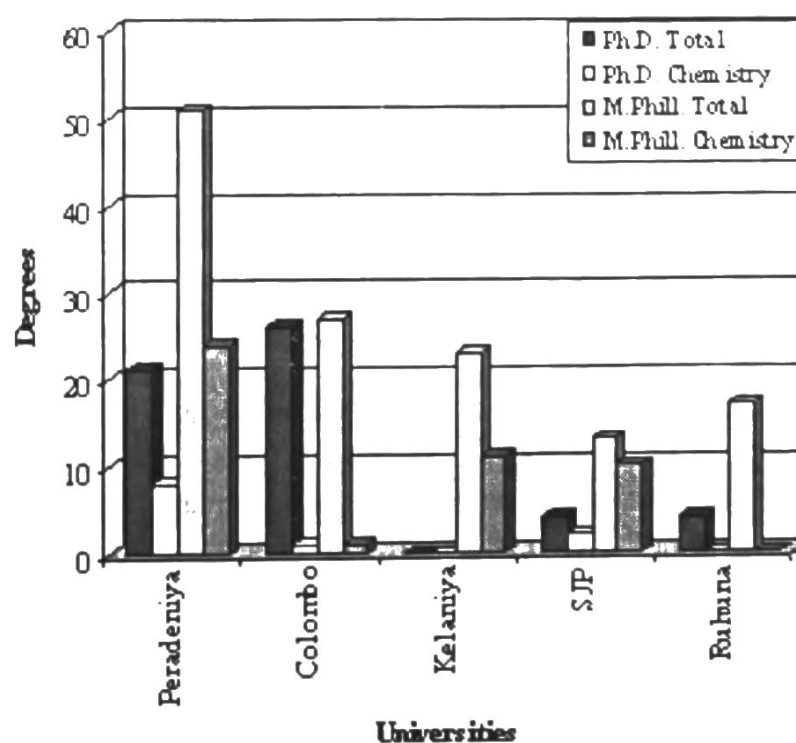
Source: Science Citation index

**Figure 6 : Publications by University 2000-2006**

The University of Peradeniya has the highest number of publications (33%), Colombo (28%), Kelaniya (17%), Sri Jayawardenepura (9%), Ruhuna (8%), Jaffna & Moratuwa (2%). The Open University of Sri Lanka and Universities of Rajarata, Wayamba and Sabaragamuwa are less than 2% each. This shows that the two traditional universities are still the main contributors to research.

### Postgraduate Degrees:

The outcome of the quality and quantity of research can be assessed by the output of the number of postgraduate students produced by such research activities. Figure 7 gives the number of Ph.D and M.Phil degrees in chemical sciences against the total, produced by the five universities, Colombo, Peradeniya, Kelaniya, Sri Jayawardenepura (SJP) and Ruhuna.



**Figure 7: Ph.D. & M.Phil. Degrees 2000-2006**

The University of Peradeniya plays a leading role in the production of postgraduate degrees in chemical sciences in the university system. During the period under study from 2000 to 2005, the University of Peradeniya awarded, 8 Ph.Ds (38%), followed by University of Sri Jayawardenepura, (50%) and the

University of Colombo, (4%). Other universities did not produce Ph.Ds in chemical sciences. The number of M.Sc. Degrees awarded by Peradeniya is 24 (47%), Sri Jayawardanepura, 10 (77%), Kelaniya, 11 (48%) and Colombo 1 (4%) during the same period.

Figure 8 gives the number of Master of Science Degrees in Chemical Sciences awarded by the five universities during the period under study.

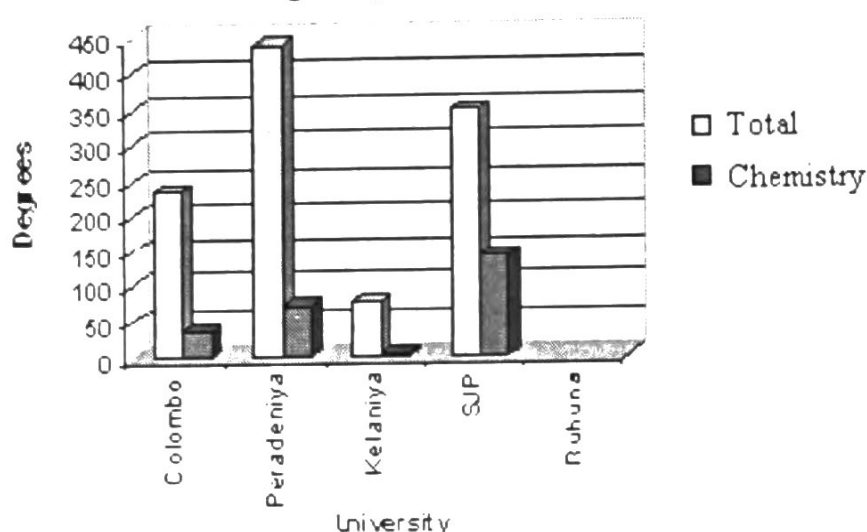
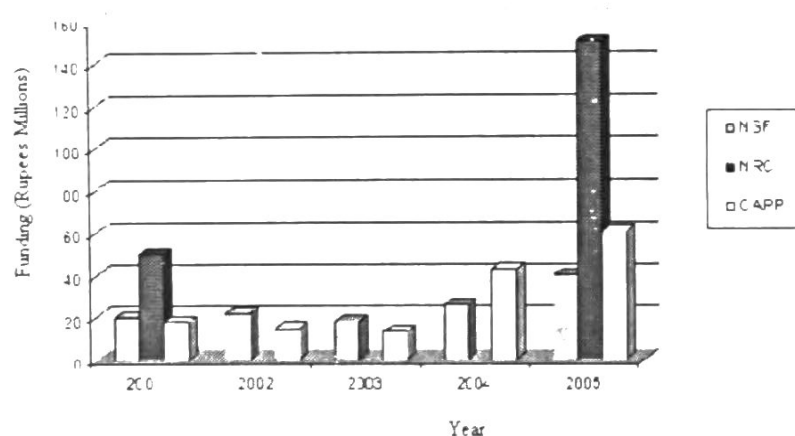


Figure 8 : M. Sc. Degrees 2000-2006

#### Funding for research:

Funding is the single most important factor for the quality and quantity of the research output. Figure 9 represents the major local funding sources for research in Sri Lanka for the period 2000-2006.



Source: NSF, NRC & CARP

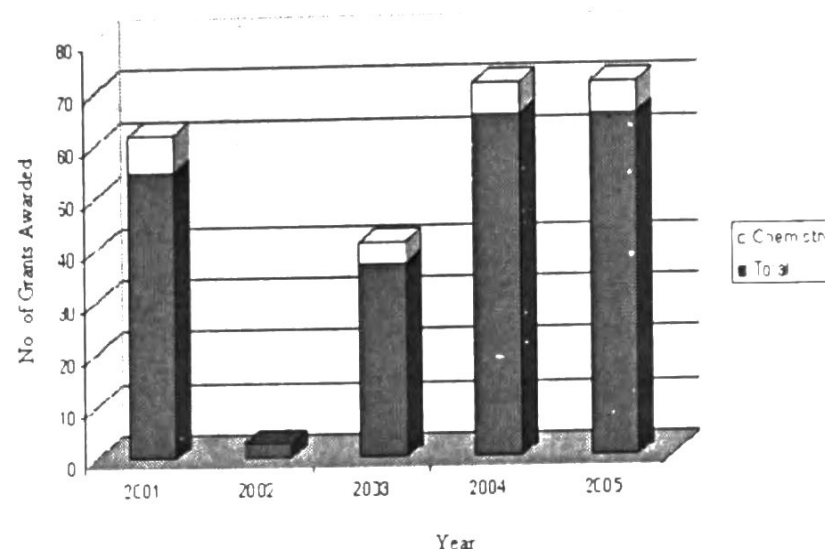
Figure 9 : Funding for Research in Sri Lanka 2001-2005 (Rupees Millions)

The major institutes that fund research in Sri Lanka are the National Research Council (NRC), National Science Foundation and Sri Lanka Council for Agricultural Research (CARP). All three institutes are government funding agencies. The National Research Council was established in 1999 to help researchers to carry out their research with minimum bureaucratic interference. NRC disbursed 60 million rupees in 1999 and 50 million in 2001. Allocation for 2005 is 150 million and out of 90 million received so far, 50 million has been disbursed. Research funding from the other two remain almost the same over the study period except in 2004 and 2005 when higher disbursement of funding is seen.

Some of the foreign funding agencies for research in chemical sciences in Sri Lanka are the IFS, SAREC, and IPICS, all three are Swedish funding agencies.

Figure 10 shows the total number of research grants awarded by the National Science Foundation from 2001 to 2005. NSF is one of the main research

granting agencies for chemical sciences.

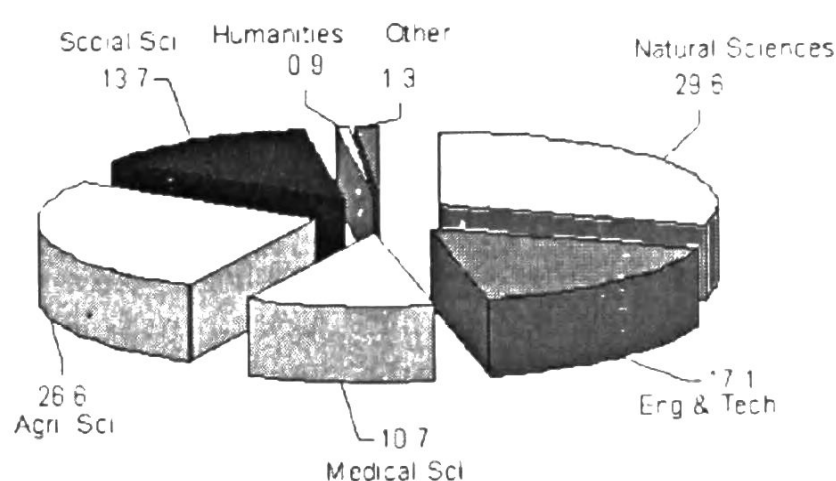


Source: National Science Foundation

Figure 10: Number of Grants Awarded by NSF Sri Lanka

Annually, chemical sciences receive about 15% from the total grants awarded. In 2002 no grants were awarded to chemistry due to the curtailing of funds for research.

Figure 11 shows the percentage R & D investment by major disciplines in 2000.

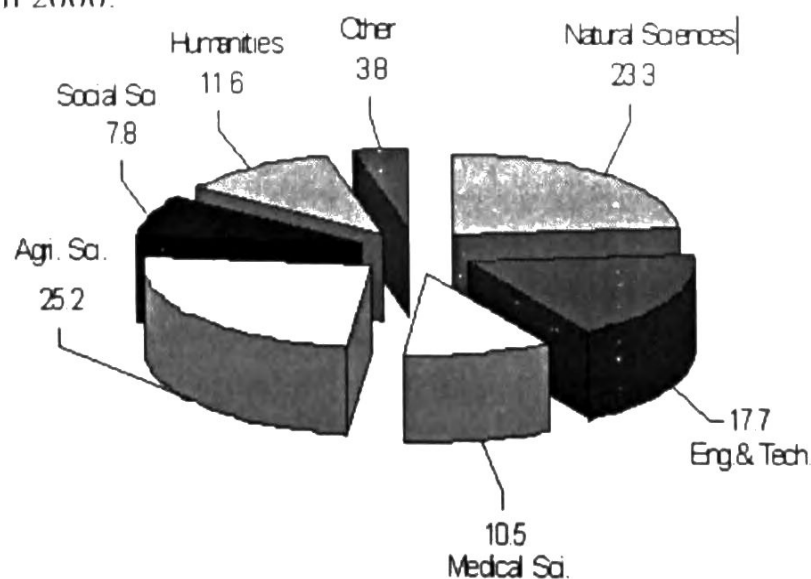


Source: National Science Foundation

Figure 11: Percentage R & D Expenditure by major disciplines 2000

Among the disciplines, the percentage research and development expenditure in the Natural Sciences is the highest with 29.6% and chemistry is included in this discipline. It is interesting to note that the R & D expenditure (26.6%) in the agricultural sector is less than in natural sciences.

Figure 12 shows the percentage distribution of personnel in Research and Development by discipline in 2000.



Source: National Science Foundation

Figure 12 : Percentage Distribution of R & D Personnel by Discipline in 2000

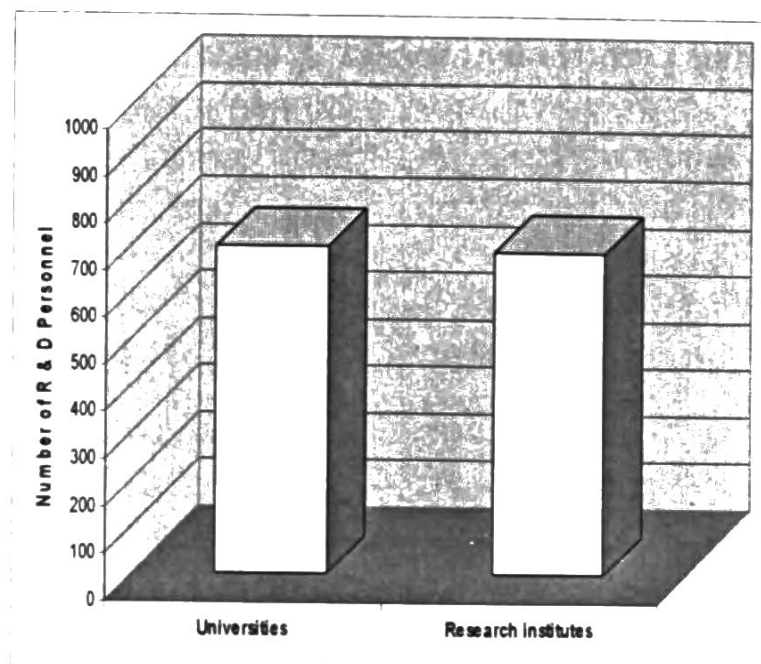
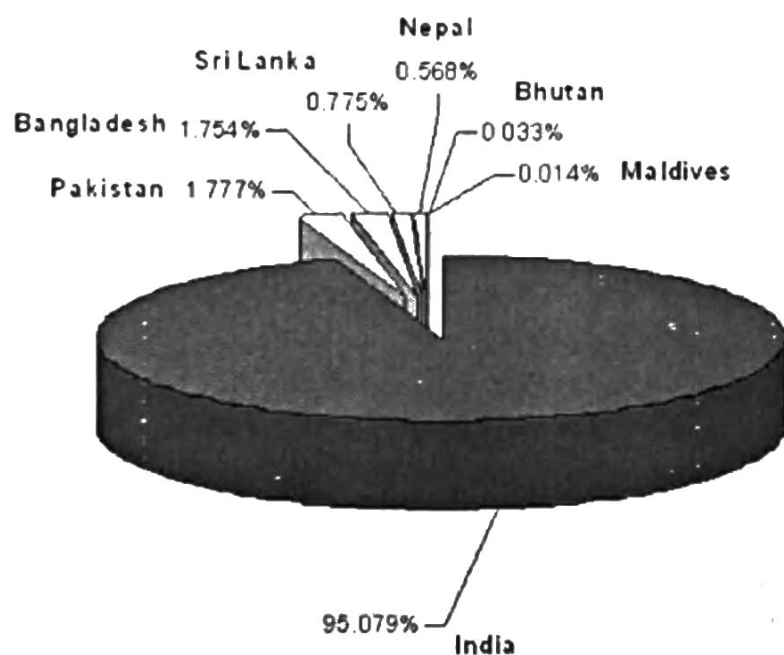


Figure 13: Personnel in Research

Agricultural Science has the highest number of personnel (25.2%) and Natural Sciences are very close to that with 23.3%. Figure 13 shows that universities and research institutes have a similar number of personnel working in different disciplines of research. However the research output of universities is much higher than that of the research institutes.

#### Research output in SAARC countries:

It is interesting to investigate the position of the Sri Lankan research output among SAARC countries. Figure 14 gives the scenario in the South Asian region. According to the Scopus data base, Sri Lanka's contribution to science in terms of publications is only 0.775% of the total output of publications in the SAARC countries.

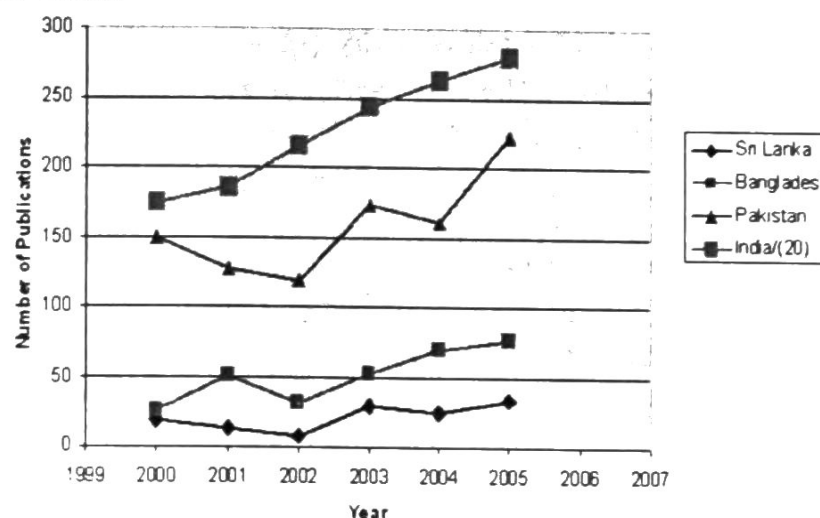


Source: Scopus

Figure 14 : Science Publications 2000-2006

The scene in the South Asian region is virtually dominated by India as expected with 95.08%. Given the high priority attributed to Science and Technology by the Indian leaders and the availability of research centres with facilities and funding in keeping with its population, India has become the leader in this region. Our performance is closer to Nepal than Bangladesh. Bangladesh and Pakistan are relatively close even though Pakistan is leading in the output of research papers. Contributions from Bhutan and Maldives are not significant.

Figure 15 gives the growth of Chemistry publications among four SAARC countries; Sri Lanka, Bangladesh, Pakistan and India during the period 2000 to 2005.



Source: Scopus

Figure 15 : Chemistry Publications, Growth 2000-2005

Compared to the other three countries, India's growth is enormous (number of publications in India is divided by 20 to bring it to scale). Moreover there is a steady growth (50%) of publications over the period 2000 to 2005. Although the growth is not upwardly uniform, Pakistan's growth of Chemistry publications reaches 66% in 2006 justifying the massive investment pumped into Science and Technology activities in recent years. It is interesting to note the pattern of research output of Bangladesh and Sri Lanka. In 2000 both countries had a similar research output. Both countries show a dip in 2000. However, output of research publications from Bangladesh shows a noteworthy increase attaining a 200% increase in 2005 compared to 2000. Research in Sri Lanka remains stagnant with a marginal increase of 30% by 2005.

Table 1 shows a comparison of the top ten research fields in four SAARC countries; India, Pakistan, Bangladesh and Sri Lanka. The positions of ranking for different disciplines in the four countries provide an insight into the direction in which the research is being conducted in these countries.

In Sri Lanka Chemistry is relegated to the 6<sup>th</sup> position. The top position is occupied by Biology and Agriculture. This is expected, considering the agricultural base in Sri Lanka and it is still one of the important sectors of the economy in Sri Lanka. The second slot is occupied by Environment, followed by Medicine and Engineering. Positions of Medicine and Engineering can be justified, as they are two important service sectors. The importance of environment is difficult to comprehend. Does this mean our research is not planned and resources available for research are generally adequate for environment research justifying its position? These data do not suggest or give any indication that we are moving in the direction of industrial development. In all the countries, except India, Biology and Agriculture occupy the first position indicating the importance of agriculture. India's top slots are occupied by Chemistry, Physics, Engineering and Material Science.

Source: Scopus

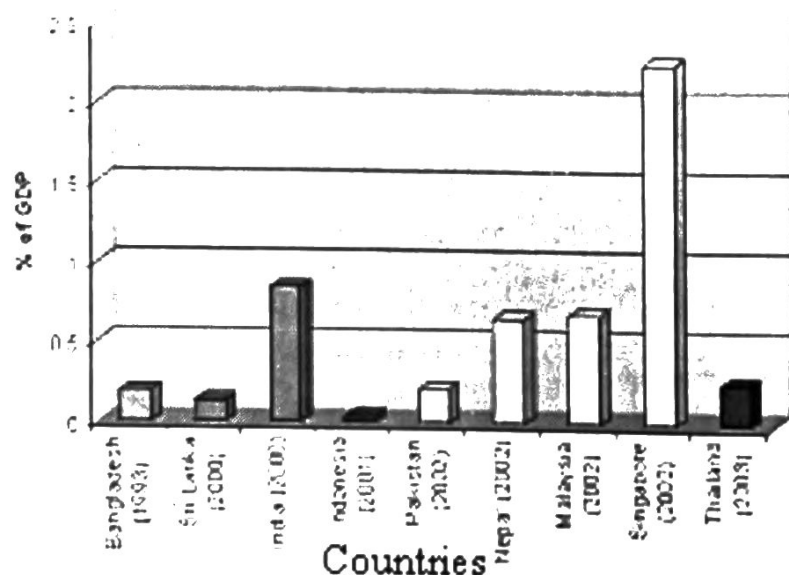
**Table 1 : The Top Ten Research Fields**

India	Pakistan	Bangladesh	Sri Lanka
Chemistry	Biology and Agric.	Biology and Agric.	Biology and Agric.
Physics	Chemistry	Engineering	Environment
Biology and Agric.	Engineering	Physics	Medicine
Engineering	Physics	Material Sci.	Engineering
Material Sci.	Biochemistry	Medicine	Biochemistry
Biochemistry	Pharmacy	Chemistry	Chemistry
Environment	Environment	Environment	Physics
Pharmacy	Material Sci.	Microbiology	Earth Sci.
Chem. Eng.	Medicine	Biochemistry	Material Sci.
Medicine	Microbiology	Earth Sci.	Chem. eng.

This clearly indicates that India has a strong industrial base. Moreover, the ranking of Chemistry and Physics in the first two slots shows the importance of basic research in industrial development. Pakistan follows suit with Chemistry, Engineering and Physics at the top slots showing its industrial capability. In Bangladesh although Chemistry occupies the sixth position, top slots are occupied by Engineering, Physics and Material Science showing that its research base is more geared to industrial development. These observations clearly show that Sri Lankan research needs proper guidance and direction under a national science policy, so that research will make a major contribution to industrial development and thereby improve the quality of life of our people. It looks as though the research in Sri Lanka is more personnel-oriented, mainly for career development rather than for what the country needs or demands.

**Investment in Research and Development:**

Investment in R & D is the yard stick to measure the development (indicator) of a country. Figure 16 gives the investment and development as a percentage of Gross Domestic Product (GDP) in the Asian region, for the period around 2000.



Source: National Science Foundation

**Figure 16 : Investment on Research and Development**

Singapore has attained the level of developed countries with a % of GDP above 2%. India has a %

of GDP of 0.8% the best in the SAARC region. Nepal has a higher contribution 0.6% better than Pakistan (0.2%) and Bangladesh (0.2%). Sri Lanka is struggling to achieve 0.18% for many years. The UNESCO Institute of Statistics, 2001 indicates that for the developing countries, expected investment in R & D is about 1%.

**Observations:**

From the above analysis, it is clear that the chemistry based research in Sri Lanka is mainly focused on the area of Natural Products Chemistry and Biochemistry. Considering the rich biodiversity of flora and fauna in Sri Lanka and its traditional medicinal base, it is not surprising that Sri Lankan researchers in natural products chemistry give priority to this area of research. For nearly hundred years, Sri Lankan natural products chemistry researchers have been engaged in extensive research programmes aimed at isolation, characterization, structure elucidation and synthesis of biologically active compounds and secondary metabolites from both terrestrial and marine plants and animal sources. During their research activities they have discovered new natural products as well as secondary metabolites showing various forms of biological activity including, antibacterial, antifungal, antifertility, spermicidal, antinociceptive, anti-inflammatory, antidiabetic and hypocholesterolaemic activities. Insect pheromones which are active as pesticides have also been discovered. A key contribution in the area of natural product research by our scientists is the contribution of a vast amount of new knowledge to the advancement of science. Even though researchers world wide have been involved in this area of research, less than 1% of flora have been studied exhaustively for their chemical composition and medicinal value. Therefore considering the large number of unexplored endemic plants available in Sri Lanka and considering its well established traditional medicinal base it is very important to continue to search for new bioactive natural products from terrestrial and marine sources. However, demand today is to isolate single compounds as leads for drug development. This needs

a high quantum of funding and foreign collaboration for the efforts to be worthwhile and successful. I believe it is essential to explore the possibilities of establishing links with centres of excellence for this purpose.

Research in Biochemistry also takes a prominent place among Sri Lankan scientists. Most of the work is done at the medical faculties of the university system. So far research has been mainly restricted to base line studies of micronutrients in Sri Lankan food and the medicinal value of plant extracts. This work also could be upgraded to *in vivo* studies using deuterated compounds and to advanced studies in enzyme activity.

#### **Future:**

It can be concluded therefore that research in chemical sciences in Sri Lanka is restricted to a few selected areas. The researchers are struggling to continue in research with constraints imposed by the lack of funds, lack of infrastructural facilities and by the bureaucracy. However, Sri Lankan Scientists must strive to be at least on par with research in the region. In order to achieve this level while continuing to work in the traditional fields, we must also aim to get into the frontiers of research. The areas we could easily consider are Medicinal Chemistry: synthesis of biologically active compounds and their modifications, search for lead compounds for drug development, studies on mechanisms of drug action; Biochemistry: studies of enzyme activity of biological pathways; drug design and synthesis: computer based drug design for lead compounds and their laboratory synthesis; Material Chemistry: studies on conducting polymers; Nanotechnology: studies on nanomaterials and devices for the development of new technologies.

If we are to venture into the frontiers of research in Chemistry we have to consider a paradigm shift from the existing scenario. The research in any country must lead to economic and industrial development of the country, thereby improving the quality of life of its people. The number one priority would be the identification of important research areas by the authorities and to establish a mechanism to allow researchers to continue with their research without any hindrance. Private sector industries are an important segment in this endeavour. Their involvement in research with funding should be encouraged as the research will ultimately contribute to the industrial development of the country. Therefore, it is essential to establish a scheme, where industries are rewarded

for their investment in research and development. A scheme of grants for about five years to new recruits to academic cadre in universities and research institutes to initiate research and to encourage them to contribute substantially to research is a long felt need. The availability of sophisticated equipment and modern state of the art computer facilities are absolutely essential for those who are involved in the frontiers of research. It is, therefore, essential that the Government establishes a National Centre for Analytical Services and an up-to-date library with data bases.

In my address, I have traced the research in chemical sciences from the beginning of the twentieth century to the beginning of the new millennium. Our progress has been found wanting. The question is, how do we get to the frontiers of research from the abysmally low level we are at present? Sri Lanka has a more than adequate human potential. It is the will of the Government that will take us to the heights that we are dreaming of. With proper planning and investment and above all with proper guidance, we are capable of easily getting there. The direction of research for the country must be decided for this activity to take off.

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### **Third Convocation**

Third Convocation of the College of Chemical Sciences will be held on Friday the 9<sup>th</sup> February 2007 at Hotel Taj Samudra. The Chief Guest will be Professor Arjuna Aluwihare, President of the National Academy of Sciences of Sri Lanka.