

## Scientific Research in a Developing Nation

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Scientific research is the systematic investigation of scientific theories and hypotheses and thus forms the foundation of knowledge. Knowledge is a vital determinant of economic growth. Knowledge is what the society creates, communicates and uses for the well being of the people. Scientific research is the major driver of social and technological innovation that can lead to national development through knowledge to action process. Skilled human resources, levels of national technological adaptation capacities as well as information and communication (ICT) facilities have a positive effect on economic growth of a country.

Developing countries with comparatively small economies, a higher population, acute poverty rates and limited technical capacity to conduct, adapt and apply scientific research are the most vulnerable to lapses of new knowledge generated through Research and Development. Significant challenges are encountered when conducting research in developing countries. Inadequate funding, limited and weak infrastructure, inadequate support services, stringent and rigid procurement procedures and red tape are some debilities which hinder the progress of research. Further, lack of appropriate policies and state patronage are also constraints encountered by scientists in developing countries.

Promoting Science and Technology and harnessing its end products are essential requirements for a country's economic development. An example is how investments in research, development and innovation have transformed Singapore from a developing nation to a thriving developed country within a span of 50 years. Through the implementation of five timely National Science and Technology plans, Singapore is now positioned as an innovation driven, knowledge based economy, with a public R & D budget of \$ 19 billion for 2016 –2020.

Korea and Taiwan are two more countries that have emerged from poverty to industrialized nations through the promotion of Science and Technology. Korea initiated activities through its first economic



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development plan in 1962, and at present has a strong economy which is mainly propelled by science and technology. According to statistics from the Asian region ([www.rdmag.com](http://www.rdmag.com)), India, South Korea, Japan and China collectively account for nearly 44% of the global R & D investment with China contributing 21.68%. In 2014, the Republic of Korea had a contribution of 4.23 (Gross Expenditure on R&D (GERD) as a percentage of Gross Domestic Product (GDP) while Singapore had 2.02 and China 2.07. All these countries now are developed nations with strong economies achieved by advancing science and technology. Though a developed country, India's contribution to R & D has been comparatively small with only 0.62% of the GDP being infused into Science & Technology.

When the status of Sri Lanka is considered, a decline in the total investment for R & D is seen, which ranges from 0.3% in 1966 to 0.11% in the year 2013.

The highest investment had been in 1974 when 0.4% of the GDP had been allocated to R & D. From 2013 to 2015, there had been no increase in funds for research, raising concerns among the scientific community on the low priority given by the state to Science and Technology.

Further, a mere 292 researchers (head count) and 106 (full-time equivalent) researchers per one million population made up our country's research base in 2015, whereas the actual need of skilled researchers for the development of Sri Lanka is far more. In the

year 2015, only 944 qualified with PhDs, 266 with MPhil qualification, 640 qualified MD/MSs and 609 with MSc qualification (Full time) constituted our research population.

National Science Foundation (NSF) and its predecessors being the premier state institutions for promoting Science and Technology in Sri Lanka, have facilitated R & D activities of Sri Lankan scientists since 1970. NSF which was the successor of the Natural Resources Energy and Science Authority (1982) and the National Science Council (1968) incorporated in 1998 through the S& T Development Act of 1994 is mandated to serve and strengthen the Science and Technology sectors in Sri Lanka. It has taken the lead in mobilizing and leveraging science to pave the way for a knowledge-based economy.

During the long journey spanning 50 years, NSF and its predecessors have established many vital and important mechanisms to strengthen the national R & D base. Many scientists currently at the pinnacle of their careers as well as budding and young research personnel, have got their research careers off the ground by securing their very first research grant from NSF and the two predecessors. NSF has a wide array of activities and Grant schemes which promote capacity building of scientists in all areas of S & T, development of research infrastructure, funding for technology transfer, knowledge creation and sharing, fostering international collaborations and science popularization to pave the way for economic success, and thereby, improve the quality of life of the people.

Through the longest standing research support scheme, the Competitive Research Grant Scheme over 2600 research grants have been awarded to date. An important output from these grants has been the training of young and budding scientists at postgraduate level, facilitating them to acquire PhDs and MPhils, thereby fulfilling one of the main needs of the country in order to move towards a knowledge-based economy.

Further, research papers written in local and international journals as well as research communications have strengthened the knowledge-base with novel findings.

Even though the Treasury allocation for scientific research has decreased in the last decade, the annual scientific publications have progressively increased indicating the high quality and acceptance of research findings of Sri Lankan Scientists.

The National Thematic Research Programme (NTRP) initiated in 2010, is a mission oriented, multidisciplinary collaborative research programme which addresses national research priorities. These contract Research Grants are expected to provide holistic and inclusive solutions to address the research problem. Under this scheme, the first theme on Food Security, has been successfully completed and yielded results with some of it already being implemented by the State. Scientific investigations on two other themes, Water Security and Climate Change (CC) and Natural Disasters (ND) are now ongoing themes. The CC and ND themes have been developed on the expectation of achieving

Sustainable Development Goal : 13, which requires urgent action to combat climate change and its impacts. Through the grants awarded under this theme, it is expected that in Sri Lanka, the main targets under this Goal (13.1, 13.2, and 13.3 ) will be achieved. The NTRP on Water Security is in line with the SDG-6, taking into consideration local, regional and global issues in the water sector.

Yet another research support scheme which promotes postgraduate research is the Research Scholarship Grant Scheme of the NSF initiated in 2004. During the period 2008 – 2017, 58 awards have been made under this scheme to support research leading to PhD and MPhil degrees for outstanding, young graduates and engineers. Further, the post doctoral research scientist grant scheme is an attraction for fresh Sri Lankan PhD holders to conduct post-doctoral research locally. These 03 grant schemes contribute significantly to the development of a strong scientific human resource base in the country.

If Sri Lanka is to keep up with the global developments, it is imperative that a critical mass of trained and skilled R & D personnel are nurtured continuously. NSF, in keeping with this requirement, initiated the Support Scheme for Supervision of Research Degrees in 2011 to motivate, support and recognize the senior scientists/ engineers engaged in supervising postgraduate students conducting research in all areas of Science and Technology. This scheme also encourages Universities and research institutions to promote and facilitate postgraduate research

training. From 2012 to 2017, through this award scheme, 218 supervisory teams have been rewarded.

A key limitation encountered by R&D personnel is the high cost of current scientific literature. The cost of subscriptions of databases and journals are beyond the reach of both individual scientists and most science libraries. The National Science Library and Resource Centre of NSF has stepped into bridge this gap and provides an efficient information dissemination service to the scientific community and access to updated literature including databases.

The Journal of the National Science Foundation is the only scientific journal in Sri Lanka, listed in the Science Citation Index of the Clarivate Analytics. Through this Journal, NSF has opened up a channel for our scientists to disseminate their research outputs to a global audience. The second Journal nurtured by the NSF, the Sri Lanka Journal of Social Science publishes social science research conducted by our researchers. During the last three years, 81 JNSF and 29 SLJSS full research papers have been published, thus facilitating knowledge sharing and dissemination.

The commitment and effort by NSF to strengthen the research infrastructure in Sri Lanka is evident by the investment of Rs 213 Million in 145 Research Equipment Grants awarded to Universities and Research Institutions during the period 2005 – 2017. Out of the 64 Grants awarded during the 5 year period from 2013 to 2017, 39 have been

used to conduct research activities funded by NSF while 289 projects funded by other sources have reaped the benefits of this facility. In mid 2000, recognizing the crucial role played by R & D in advancing socio economic development, NSF spearheaded the National Nanotechnology Initiative, which culminated in setting up of the Sri Lanka Institute of Nanotechnology (SLINTEc) in 2008. This is now the foremost institution in Sri Lanka for cutting edge nanotechnology research. The setting up of a Nanotechnology Park in Sri Lanka has also been initiated. NSF also initiated several other grant schemes including support for technology development and to begin businesses based on novel technologies to propel industry-oriented research.

International Travel Grants, Overseas Training Programmes, Funding for S & T Publications, supporting page charges of research papers published in indexed journals are some other much sought-after facilities that NSF offers to our scientists who attempt to excel in their research efforts.

Focusing on strengthened bilateral scientific cooperation and harnessing the benefits of same for the development of the country, NSF initiated bilateral collaborative research programmes with the Pakistan Science Foundation, German Research Foundation (DFG) and DAAD (The German Academic Exchange Service) of Germany, Japan Science and Technology Agency (JST) and National Natural Science Foundation of China (NSFC) with more to come. It is expected that



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these joint research programmes which include exchange of researchers, will enhance the research skills and expertise of our research community to serve the nation better.

From its humble beginning as National Science Council in 1968, NSF has developed into a

fully fledged funding authority, through the vision and leadership provided by successive Boards of Managements. It plays a pivotal role in national development.

NSF has qualified and committed staff to carry out the mandated activities. With this backdrop and the firm support of the government by investing sufficient funds, the granting of R & D tax incentives, the permitting of flexible but transparent procurement methods and the willingness of our scientists to forge ahead

despite impediments, Sri Lanka can look forward optimistically to a knowledge-based, strong economy in the foreseeable future.



**NSF Research Summit - 2016**



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## STEPS IN CONDUCTING A RESEARCH PROJECT

### Step 1: Identify the Problem

The first step in the process is to identify a problem or develop the research question. The research problem may be something identified as a problem, some knowledge or information that is needed by an organization.

### Step 2: Review the Literature

The researcher must learn more about the topic under investigation. To do this, the researcher must review the literature related to the research question. This should cover local and global literature including recent research activities. This step provides knowledge about the problem area. The review of literature also educates the researcher about what studies have been conducted in the past, how these studies were conducted, and the conclusions in the problem area.

### Step 3: Clarify the Problem

Once the literature review has been completed, researcher may expand/narrow down the scope of the research project.

### Step 4: Define the objectives and hypotheses

Define the general & specific objectives. Objectives are the broad statements of desired outcomes. They should be clear and summarize what is to be achieved from the project.

### Step 5: Methodology

This is a very crucial & important part of the research project, which will decide the success or failure of the research project. Methodology has to be very precise and accurate and should be aligned to achieve the proposed objectives.

For research projects involving human subjects/animal models it is mandatory to obtain ethical clearance from the relevant institution.

### Step 6: Results and Discussion

The collected data has to be analyzed through appropriate and relevant tools (including statistical methods) to yield the expected outputs. The results have to be carefully interpreted to formulate the discussion. The negative results obtained, if any should also be discussed here.

### Step 7: Conclusions

It is very important to give clear conclusions based on the results obtained. Further research needed stemming, from the research project can also be included in this section.

### Step 8: List of References

References that are used for the research study should be listed.