GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF SCIENCE & TECHNOLOGY
LOK SABHA
UNSTARRED QUESTION No.1719
TO BE ANSWERED ON 08/12/2021

DEVELOPMENT OF NANO SCIENCE TECHNOLOGY

1719. SHRI GNANATHIRAVIAM S.:

Will the Minister of SCIENCE AND TECHNOLOGY विज्ञान और प्रौद्योगिकी मंत्री **be pleased to state:**

(a) whether the Government is aware of the local mission of research and development of Nano Science and Technology;

(b) if so, the details thereof and the steps taken for development in the field;

(c) whether the Government proposes to allocate more funds to encourage effective research work in this field; and

(d) if so, the details thereof ?

ANSWER

MINISTER OF STATE (INDEPENDENT CHARGE) OF THE MINISTRY OF SCIENCE AND TECHNOLOGY AND EARTH SCIENCES (DR. JITENDRA SINGH)

विज्ञान और प्रौद्योगिकी तथा पृथ्वी विज्ञान मंत्रालय के राज्य मंत्री (स्वतंत्र प्रभार)
(डॉ. जितेंद्र सिंह)

(a) Yes Sir. The Government of India (GOI), through Department of Science and Technology (DST), launched Nano Science and Technology Initiative (NSTI) in October 2002 to promote research and development in advanced area of Nano S&T. The initiative that was launched, was in line with similar initiatives launched by the developed countries across the world like USA, South Korea, Germany etc. Japan, a leader in Nano R&D, had an early launch almost at the starting of early 1990s.

(b) DST was assigned the nodal Ministry/ Department for the promotion of R&D in Nano Area. As a follow-up of this initiative, the GOI launched the Nano Mission-Phase I (2007-12) as an "Umbrella Capacity Building Program",

anchored by DST, with an allocation of Rs. 1000 crores for 5 years. During this period DST supported Nano Science Units in several Institutes/ Universities/ National Labs like Indian Institute of Science-Bengaluru, Indian Institute of Technology - Mumbai, Kanpur, Varanasi and Chennai, Tata Institute of Fundamental Research (TIFR), Mumbai. At the end of Phase-I, in 2011, 4 Computational Materials Science units for exploring new Advanced Nano Materials and its applications were also set up at JNCASR-Bengaluru, Indian Institute of Science-Bengaluru, SN Bose National Centre for Basic Sciences and SP Pune University, Pune. The DST had spend Rs 568.83 crore in this Nano Mission Phase-I.

During the same period, the other scientific Ministries/ Departments/ Agencies recognising the advantage of Nano Size materials R&D also started promoting Nano R&D in their own specific domain. As a result, of these combined R&D efforts by all S&T Departments/ Ministries & other S&T funding agencies, India's position in Nano S&T research publications, that was at twelve position globally in 2002, improved to sixth global position in 2010. It may be noted that since 2005-12, India has been ranked globally as the third fastest growing nation with a Cumulative Aggregated Growth Rate (CAGR) of 29% in scientific publications in Nano Science and Technology. This growth resulted in India reaching the third global position in 2013-14, which it has retained till now, in terms of research publications in the field of Nano Science & Technology. The Nano Mission was brought under Research and Development Programme in 2017-18 with more focus on developing Nano Technology. In 2019, we supported an Industry-Institute Joint project on development of inner anti-rust coating in pipes used for Chemical and Petro-chemical industries.

Subsequent to launch of Nano Mission Phase – I by DST, D/o Electronics and IT (DeitY) initiated a programme to establish Nanotechnology Initiatives Division to provide competitive support to carry out R&D through Grant-in-Aid (GIA) with a focus on developing Nanoelectronics based technologies and its commercialization. Other respective S&T Ministries/ Departments/ S&T Funding Agencies like D/o Biotechnology, CSIR, ICAR, ICMR, DoS, DAE and DRDO also started supporting R&D in Nano Science and Technology field in their respective domain though their EMR support Schemes. Representatives of all these funding agencies are involved in all meetings of DST.

In 2005, MeitY through one time funding of Rs 100 crore established two state of the art Centre of Excellence in Nano Electronics Research (CENs) at IIT-Mumbai and IISc-Bengaluru respectively to carry out R&D in Nanoelectronics area. R&D carried out at these Centres have resulted in many nanoelectronics based technologies/ sensors. Recently, MeitY and DST had funded a major project titled NNetRA (Nanoelectronics Networking for Research and Application) at IISc and IITs at Mumbai, Chennai, Kharagpur and New Delhi at a total cost of 299 crore, with financial support distributed of 1:1:1 between DST, MeitY and the Institute. The objective of this project is to upgrade projects technologies from TRL 3-5 to TRL - 8-9 (Industry ready technologies for transfer). With two level monitoring done every 6 months followed by a Project Steering Committee every year, the Institutes have been able to upgrade TRL levels of 17 technologies to make them industry ready. These technologies are in five specific areas namely Agriculture, HealthCare, Environment, Devices and Security and Safety.

The Indian Council for Agricultural Research (ICAR) had also initiated R&D in various fields of agriculture and allied areas employing Nanotechnology from 2OO4 onwards. The important areas which they are exploring include:

- **Developing Polymeric Nano Materials for Packaging and Efficient Delivery of Nutraceuticals;**
- **Nano-based detection of organophosphate pesticides using metal-organic framework conjugates;**
- **Effective delivery of nutrients, insecticides and fungicides through nano-particulates for better yield of ground nut and Chilli;**
- **Development of nano-particle (NP) based RNA delivery system for imparting resistance to viruses;**
- **Effects of metal oxide nanoparticles on soil bacterial communities; and**
- **Improvement in cotton Fabric quality by plasma Nano Technology and using Novel Nano coating for imparting antibacterial and UV protection properties in cotton and other textiles.**

The key areas of Nanotechnology related research in Animal and Dairy Sciences include;

- **Development of thermostable peste des petits ruminants (PPR) vaccine;**
- **Using spontaneously assembling of bio-degradable mesoporous silica nano-scaffolds;**
- **Characterization and studies on residual effect of iron oxide nano particles on frozen bovine spermatozoa;**
- **Development of stem cell laden nanomaterial scaffold for nerve, bone and cartilage tissue regeneration in animals;**
- **Development & Evaluation of a nano-carrier based novel Foot-and-Mouth disease virus vaccine for non-parental delivery;**
- **Nanoparticles as delivery vehicles for fortification of milk and milk products etc.**

Recently, the IFFCO's Nano Biotechnology R&D Centre at Kalol, Gujrat has developed liquid Nano Urea that may be a good substitute for solid Urea, since plants can absorb upto 80 percent of Nano Urea which is in the form of a stable particle as against solid Urea which is absorbed as ion that is unstable.

DST, for manpower training, also has Domestic Post-Doctoral Fellowship programme, where candidates who have completed/ submitted their Doctoral Thesis can apply. Also, to generate specialized manpower in the NanoElectronics Area, MeitY has been supporting a programme called Indian Nanoelectronics User Programme (INUP) since 2008 with DST PIs also emanating from this training at CENs. In September, 2021, MeitY has approved new training programme namely INUP-i2i (Indian Nanoelectronics User Programme-Idea to Innovation) at IIT-Mumbai, IIT-Chennai, IIT-New Delhi and IIT-Kharagpur and IISc to provide the facility at these CENs to maximum researchers in the country, thus expanding the user base and also support/mentor Start-ups/Industry and R&D projects in the nano field.

On the International Collaboration front, Nano Mission now NPNST has already collaborations with DESY, Germany for use of State-of-Art Synchortron namely PETRA-III by Indian Users. In fact, India has contributed for building a India specific Beam Line at PETRA-III against which, DESY has allowed 758 days of Beamline time on the remaining 22 beam lines which has been successfully utilised by Indian Scientists. As a result of this, the DESY has signed an MoU with JNCASR on behalf of DST for further cooperation on similar lines for next 5 years. Till February, 2020, the number

of Scientists and students who visited PETRA is 53 with 41 Joint papers published in Journals of repute.

Similarly, we have arrangement with KEK Photon factory under the Japan Agreement for utilising the photon beam lines by Indian Scientists. We have funded an instrumentation attachment with a specific Beam line that is used extensively & dedicatedly by Indian Scietists with Scientists from other countries joining on a competitive basis. We are about to complete the Phase-II of KEK Photon factory and the Joint Steering Committee has given a go ahead to prepare the proposal jointly for Phase-III, which will be processed shortly. Till December, 2020, 243 Scientists and their students have used the facility with 143 Joint Publications in leading Journals.

The third International Collaboration is with Rutherford Appleton Laboratory in Oxfordshire, UK where ISIS Neutron and Muon Source, available in RAL Lab is used by the Indian Scientific Community since 2015. It is a world-leading Centre for Research in the Physical and Life Sciences and the UK Science and Technology Facilities Council (STFC) owns it. ISIS Neutron and Muon Source produces beams of neutrons and muons that allow scientists to study materials at the atomic level using a suite of instruments, often described as 'super-microscopes'. Till March, 2021, 104 Scientists and their PhD students have visited RAL facility and have 20 Joint Publications in leading journals. The STFC is keen to collaborate further for 5 years more and are currently engaged with their Indian Counterparts in developing a Detailed Project Report for submitting the same soon to DST for further processing.

Apart from these three International Collaborations, we also support Indian Scientists for using other beam-line facilities in France, South Korea etc, where they are allotted beam-time on a competitive basis by the facility managers.

(c) & (d) DST, DBT, MeitY, ICAR & ICMR have been continuously providing/ allocating funds to Nano S&T which are limited due to allocation to each body. In fact the output per Re spent is perhaps higher than many of the developed countries. The allocation of core grants to Autonomous Institutes of DST working in the area of Nano S&T has also increased over the last 3 years as is evident from the table below:

Allocation of grants to AIs during the last 2 years

(Rs in Lakh)

S.NO	INSTITUTE	2019-2020	2020-2021	% increase
1.	INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE (IACS), KOLKATA	11684.72	12763.00	9
2.	CENTRE FOR NANO AND SOFT MATTER SCIENCES, BENGALURU	1358.46	1374.00	2
3.	INSTITUTE OF NANO SCIENCE AND TECHNOLOGY (INST), MOHALI	2709.00	3189.00	17
4.	INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS (ARCI), HYDERABAD	5201.13	6116.00	17
5.	JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH, BENGALURU	10928.16	10267.00	--
6.	S.N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES (SNB), KOLKATA	3438.64	4469.00	29
		35320.11	38178.00	8

The conversion of Nano Mission into a regular scheme has been recommended by the Third Party Evaluation Committee that evaluated all Schemes of DST, since work in this inter-disciplinary area is/ has opened up several avenues right from Novel Nano Materials with variable parameters for use in Automobiles/ Aircrafts etc. for lighter weight to Nano Electronic based devices, Nano Pharmaceuticals for Health Care to Nano – Agro Food with high nutritional value and Nano based security devices.

Further, it is becoming difficult to undertake such Applied and Translational R&D in Nano S&T area, for technology development for societal benefit. Therefore, the need for providing sustained and more support in this sector would surely make the area attractive for R&D and sustainable in the long-run. This needs to be executed through a coordinated way with close dialogue with the other User Ministry/ Department/ S&T funding body in a meaningful way. This may open means for suitable funding to Nano S&T, if done in a proper coordinated way, to avoid duplicities/ redundancies in funding.

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