

Public Communication on Science and Technology

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Abstract: *'Comfort living' is the indicator of the development of a nation. Comfortable and prosperous living cannot be imagined without proper use of science and technology (S&T). And, technology cannot survive without a strong foundation of development in science. S&T research in nanotechnology promises breakthrough in medicine and healthcare, energy and environment, nanoelectronics and national security etc. It is widely felt that nanotechnology will be the next industrial revolution. We Nepalese people are unfortunate since we don't have proper national planning in S&T and let it be kept into least priority.*

Keywords: Nanotechnology, healthcare, sustainable development, technology center, national policy.

1. INTRODUCTION

Science has achieved tremendously for the development of humankind in every walk of life. Creation of wealth and enhancement in quality of life depends on the ability to create and exploit scientific knowledge. Application of scientific knowledge in new products and processes has made our socio economic transformation rapid and immediate. It is evident that better application of innovation in science & technology (S&T) are now keys to improve economic growth and social well being. Development of pest resistant crops to preservation of perishable foodstuffs, improved health care products to prevention and treatment of diseases, prevention of environmental pollution to affordable energy uses etc. are only few examples. This is why massive investment in science, technology and innovation by developed as well as countries of emerging economy. In addition, countries of emerging economy like Brazil, China, India, Mexico and South Africa are spending more on R&D than before. The rise in gross domestic expenditure on R&D has been regarded as the corollary of strong economic growth. Economy thrives only when S&T support the commercialization. Thus, advancement in scientific research and technological innovations are important drivers of economy, nowadays.

Field of industrial production whether pharmaceuticals, food production, agriculture or engineering, science technology and innovation is the prerequisite for their success (Avouris, 2009). Problems like fighting against disease, solving population growth and urbanization, coping with climate change, confronting energy crisis, halting soil degradation, preserving forests, fisheries and biodiversity can be solved with S&T for the development of society and nation as a whole. Alleviation of poverty, provision of more equitable and sustainable future for all requires new integrated approaches that fully incorporate existing and new scientific knowledge. The scientific and technological community can make a leading contribution to tackle major problems identified in the millennium development goal and recently agreed by the UN "the Future we want". To achieve these goals a strong partnership between S&T community and other members of civil society, the private sector and the government is a fundamental prerequisite.

Role of Science and Technology for the Sustainable Development

The aspiration to have better quality of life is undebatable, universally. The need for efficient use of resources to meet the demand of improved quality of life has been increasing. Although

level of consumption differ enormously between regions of the world. But responsible Consumption and production of resources are key elements of sustainability (Lewis & Nocera, 2006). Sustainable development can be achieved through the development of S&T that propagate cleaner and smarter technologies which are energy efficient and do minimal impact to the environment.

There has been progress in S&T, including information and communication technology in our country. Meeting human needs, now and in future, remains a major challenge. The progress made in healthcare, improved nutrition and healthier life style is leading to increased survival and increased aging of the population (Hicks & Dresselhaus, 1993). The wellbeing of a growing number of human needs require special attention in order to make advanced healthcare available for all. The enormity of unsatisfied human needs threatens social cohesion as well as the equilibrium of the living systems of the planet (Humphrey & Linke 2005), and hence S&T is under pressure to develop solutions. Investment and expertise is prerequisite for the development and innovation in S&T.

Science and Technology in Nepal

With a view to promote S&T in the Country, Nepal Academy of S&T (NAST) was established in 1982 as the first national scientific organization. The purpose of the academy was to intensify Science, technology and innovation for overall development of Nepal. NAST activities are focused mainly on promotion of S&T through various programs like national conferences, science awareness program, scientific publications, awards and prizes incentives for scientific achievements, etc. In addition, it aims to advise the Government on promotion of S&T.

Ministry of Science, Technology and Environment (MoSTE) is an umbrella agency to coordinate and promote S&T in the country. Ministry is now proposed few research centers like: Bio-Technology and Nuclear Technology etc. Few others like space technology and nanotechnology are in pipeline.

The concept to establishment of such centers is based on priority set by the periodic plans incorporated with government policies formulated at different span of time. Detailed studies for their establishment, advantages, resources, technical skill and challenges are to be explored. It has been realized by the scientific communities together with consultation among related stakeholders like: government agencies, universities and other professional organizations that there is necessity of creating and developing specific centers in the country with added vigor and enthusiasm. In the following, attempt has been made to explain prime most one of them in brief.

National Nanotechnology Research Centre

Technology can be utilized to solve problems to human needs and has been a powerful tool in the development of human civilization. Scientific knowledge has often led to the application in the society in the form of technological products. Coordinated development of complete set of compatible technologies taken together plays crucial role for national development. As an example, the development of atomically precise nanotechnology is an ongoing process and forward from current atomically precise manufacturing (Boukai *et al.* 2008). This initial roadmap explores a small part of a vast territory of radical innovation in technologies (Martin, Aksamija, Pop & Ravaioli 2009), yet even this limited exploration reveals rich and fertile land.

Nono-science and nanotechnology (NT) is multidisciplinary and rapidly evolving field related to many branches of science. Graduates in the field of NT are proven to have wonderful career prospects all over the globe. Students from natural sciences, engineering and even mathematics can pursue a career in NT, so that it is considered to be a multidisciplinary area. New materials are the foundation of major technological advances. In the coming decade, NT will have an enormous impact in the area of nano-electronics and computer technology. NT will allow the construction of small circuits and computer. Smaller circuits will run

faster enabling far greater computer speed (Poudel *et al.* 2008). For the environment and energy, NT will have significant impact. For example, nanometer sized solar cell could be developed to provide much of the efficiency of fuel cells and batteries. In future NT will be used to tackle environmental problems. In health care and medicine, biological nano-sensors are being developed and will be used for fast and accurate diagnostics. In addition, it may be used to build artificial muscle and 'lab on a chip' technology will develop more efficient drug discovery process.

It is known that nano-scale particles are likely to be more reactive than the same material in bulk and those nano particles may be able to penetrate human cells. Nano-medicine is the application of NT to medicine by using molecular tools and molecular knowledge of the human body. Present day nano-medicine exploits carefully structured nano-particles such as dendrimers, carbon fullerenes and nano-shells to target specific tissues and organs. These nano-particles may serve as diagnostic and therapeutic, anti-viral, antitumor or anti-cancer agents. The ability to build medical nano-robots to molecular precision will revolutionize the practice of medicine and surgery. Such a device could perform various functions such as searching for pathology and then diagnosing and correcting lesions by nano-manipulation, coordinated by an on-board computer while maintaining contact with the supervising surgeon, via coded ultrasound signals.

Nano Structures refer to the material systems with length scale in the range of $\sim 1-100$ nm in at least one dimension. There are often advantages in making devices smaller, but how small a device can be made? Any device must be composed of atoms, whose sizes are in the order of 0.1 nm. The idea of the limiting size scale of miniaturized technology is fundamentally interesting for several reasons. NT is particularly concerned with the smallest devices that are possible, and equally with the laws of nano-physics, which accurately predicts the behavior of matter on this invisible Scale (Hochbaum *et al.* 2008). As we know, the properties are changed greatly when the materials is reduced into

individual atoms. A significant fraction of atoms in nano-structure is located at and near the surface or interface. Therefore, properties of nano-structures can be widely adjustable by changing their size, shape and processing conditions. Thus, significant property changes often start when we go down to the nano-scales.

Though the field emerged lately, many developed as well as developing countries of the world have already established a full-fledged functional Nanotechnology Research Centers. Nepal is a country with limited resources and situated between two giant neighbors and not been able to develop marketable technologies. It is therefore, a timely call to establish such a research center as a model platform for scientists, technologists and researchers, academicians and entrepreneurs of national patriot to carry out collaborative research in real sense in the days ahead. On these backgrounds, Nepal urgently need to establish a modern scientific and technological research centre that will focus on research related to a multidisciplinary area (NT) and apply its outcomes to make our society a better place to live in.

2. OBJECTIVES

Following could be the objectives for establishment of NT Research Center in the country.

1. Exploit full potential of the Nepalese scientists, technologists, and young researchers in different disciplines of S&T to deserve native NT in the country. Create environment for the Nepalese researchers to stay in Nepal and those working abroad to come back (Brain-Gain) and involve in research activities within the country
2. Collaborating activities to raise capacity proactively engaged with the sustainable development at national, regional and international levels and show our presence in broader scientific communities.
3. To build national capacity to carryout research activities in NT for Masters as well as Doctoral degrees. Ensure Nepalese Scientists/ Technologists carry out research activities as par with countries abroad.

4. To attract industries invest in R&D and also initiate venture company in public-private partnership. To make the country capable in advancing and adopting modern technology
5. To prove the country can make a quantum jump in improving the quality of life of our people by developing our own innovative technologies.

Main Features of Nanotechnology Centre

1. The basic requirement for a Nanotechnology Centre will be a central nanotechnology laboratory equipped with fundamental nanoanalytical techniques.
2. The centre should promote interdisciplinary research activities among the networks of chemists, physicists, engineers, materials scientists, geologists and biologists.
3. The proposed centre should be equipped with the facilities to study the molecular level phenomena in biological systems, to allow controlled synthesis and manipulation of nano-objects and their characterization.
4. For the development of natural medicines, it is essential to fully characterize the chemical ingredients present in herbal plants and develop our own controlled drug delivery system. This facility should be available in the proposed nanotechnology centre.
5. Strong collaboration among scientists from universities, research centres and industries. The involvement of industries in this initiative is very important. The interdisciplinary researches leading to PhD degree should be promoted. The exchange of knowledge through collaborative researches (joint venture projects) with other laboratories (foreign and national) should be promoted.

3. RATIONALE

“The aim of nanotechnology is to build the future, molecule by molecule.”

Out of applied research area, **Nanotechnology** seems to be new and it is likely that Nepalese researchers can catch up the current pace of its

progress in the world, if research facilities and resources are put in place without delay. Research in world class laboratories with the fundamental aim of innovation and implementation of developed technology can provide ample opportunity to the trained brains to use their knowledge inside the country and on the other hand initiate a new era of research with spontaneous and active participation of industries. This is the only way how newly emerged economically giant countries of Asia have transformed their status. Nepal needs at least one such centre urgently to streamline the existing manpower in their respective specialized area of research. Due to lack of appropriate priority, our country could not experience a breakthrough in technological innovation and its transfer to the industries for economic development (Chang, Okawa, Majumdar & Zettl 2006). To address such genuine issues ministry of S&T now proposed Nanotechnology Research Centre is expected to be established in the top priority.

On the other hand, our country is blessed with abundant and highly diversified natural resources. Nepal possesses one of the richest world reservoirs of the medicinal plants thanks to the presence of a wide variety of flora. It has been repeatedly emphasized that we belong to one of richest countries worldwide in water-resources sector. Likewise, as demonstrated by several studies by the experts in the related field, there are wide varieties of useful minerals in different parts of the country. However, till date, we have been able to make only limited efforts for the sustainable utilization and development of the existing natural resources our country. Now, the time has come for us to focus our efforts to properly utilize nanotechnology for the achieving our goal of new and prosperous Nepal. Unless we develop our own stream of nanotechnology and biotechnology, it is very likely that we will be tracked outside the upcoming industrial revolution (Cahill, Watson & Pohl 1992).

4. ACTIVITIES

Realizing the burning issues of the country, following could be the area of applications of NT to

begin with.

- Nano electronics
- Nano mechanics/materials/structure
- Nano medicine
- Nano photonics
- Nano fabrication - photolithography
- Nano biotechnology
- Nano tech in energy and environment etc.
- Computational nanotechnology

The activities and timeline of such center can be prepared in details depending upon the availability of resources and a policy along with national commitment to establish such a full-fledged research center which is expected to be the milestone in the history of scientific and technological development in Nepal.

5. CONCLUSIONS

Science teaching must incorporate the broad brush of tools required for convergent technology. Students will need a strong understanding of fundamental sciences such as physics, chemistry, biology, information technology but importantly must also appreciate the cross disciplinary applications that underpin nanotechnology. Since, engineering of nanoscale materials is important in biological systems because most of the critical biological interactions are on the nanoscale. By integrating biology with electronics, particle chemistry and information technology, nanobiotechnology offers solutions to many challenges in drug development, diagnostics, food production and processing, as well as environmental remediation. Nanotechnology is

starting to have an impact on our everyday lives with the potential to become important drivers for Nepal's international competitiveness and economic growth. The time appears ripe for the formation of a nanobusiness alliance with the help of government to assist, within the appropriate infrastructure and regulatory environment of nanotechnology R&D strategies within mainstream firms.

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