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Science and Technology for indigenous development in India

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Introduction

Science & technology is widely recognized as an important tool for fostering and strengthening economic and social development of the country. Greater emphasis is on the development of indigenous technologies. At the macro level, S&T management should focus on meeting the needs of the nation (including industry), and encompass a wide spectrum of activities, namely basic research, applied research, technology transfer, design development, fabrication, tests and trials, manufacturing, marketing, maintenance and product support during the life cycle. At the micro level, R&D institutions and the academia must move from R&D to R&D and Engineering so that the indigenous technology can meet the specific requirements of the Indian industry.

Four pillars of Indian science and technology

Science and technology in India rest on four pillars:

1. **Techno-nationalism:** In some fields, despite making every effort, India could not obtain certain technologies, and the country had to make do with export control regimes. In addition, it was denied so-called "dual-use" technology. In response, India developed its own technologies in space, defence, nuclear energy, and supercomputers, among others. All were institutionally led, mission-based technology delivery systems.
2. **Inclusive growth:** In S&T, where consideration of the population had been excluded, it is now included in the development and growth process. This means making S&T work on behalf of the poor of India, combining equity and excellence, creating products within the price-performance envelope that are suited to those at the bottom of the pyramid and to the needs of India's lower-middle class. Discovery, development, and delivery of drugs and therapeutics vaccines that are available, affordable, and accessible to the poor is one example. The recent launch of the Nano automobile by Tatas, a low-cost

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(US$2500) vehicle for the lower-middle class, is another example. The green revolution, which made India self-sufficient in food belongs to this category too, since its effect was to include a vast majority of rural farmers who were otherwise excluded.

3. **Techno-globalism:** This refers to the strong interactions between the internationalization of technology and the globalization of the economy, a widening cross-border interdependence between individual-based sciences and economic sectors, and the location of knowledge production centres in countries that offer the required skill base at low cost. In India, this led to multiple offshore R&D services utilizing India's low-cost scientific manpower. This resulted in Indian S&T talent being used within the country, rather than outside the country, to create technology for global players.

   For example, GE set up its R&D in India because India offered the highest intellectual capital per dollar spent. Taking advantage of this, more than 300 multinational companies have set up their R&D centres in India, including GE, IBM, Microsoft, Dupont, Dow, Shell, and General Motors. Indian scientists and researchers have created intellectual property for numerous foreign firms. This trend toward globalizing R&D is expanding into other activities, including diverse types of knowledge process outsourcing, other IT-based services, and clinical trials and testing, all at similar cost advantages.

4. **Global leadership:** Such leadership demands substantial improvements in the quality of basic research, creating 'innovation ecosystems' comprised of forward-looking intellectual property (IP) laws, venture capital, and so forth. The aim is to see that tomorrow's Silicon Valley and Genome Valley are created in India. This also means that Indian IQ will not be used just to create IP for multinational companies (as is implicit in S&T techno-globalism), but Indian IQ will generate IP for Indian companies as they step up their R&D spending by several orders of magnitude. This leadership will also coincide with stronger participation among globally dispersed Indians and their eventual return to India, as is already beginning to happen. It also means that the "brain drain" phenomenon will be reversed.

What is Indigenous Knowledge?

The increasing attention indigenous knowledge is receiving by academia and the development institutions has not yet led to a unanimous perception of the concept of indigenous knowledge. None of the definitions is essentially contradictory; they overlap in many aspects. Warren (1991) and Flavier (1995) present typical definitions by suggesting:

Indigenous knowledge (IK) is the local knowledge – knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities. (Warren 1991)

Indigenous Knowledge is the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems. (Flavier *et al*. 1995: 479)

While using similar definitions, the conclusions drawn by the various authors are, controversial in a number of aspects. The implications of this will be discussed in the section "Public debate on indigenous knowledge". Most authors explain their perception of indigenous knowledge, covering only some aspects of it.

Why is Indigenous Knowledge Important?

In the emerging global knowledge economy a country's ability to build and mobilize knowledge capital, is equally essential for sustainable development as the availability of physical and financial capital. (World Bank, 1997) The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood.

Significant contributions to global knowledge have originated from indigenous people, for instance in medicine and veterinary medicine with their intimate understanding of their environments. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values. Indigenous knowledge is also the social capital of the poor, their main asset to invest in the struggle for survival, to produce food, to provide for shelter or to achieve control of their own lives.

Today, many indigenous knowledge systems are at risk of becoming extinct because of rapidly changing natural environments and fast pacing economic, political, and cultural changes on a global scale. Practices vanish, as they become inappropriate for new challenges or because they adapt too slowly. However, many practices disappear only because of the intrusion of foreign technologies or development concepts that promise short-term gains or solutions to problems without being capable of sustaining them. The tragedy of the impending disappearance of indigenous knowledge is most obvious to those who have developed it and make a living through it. But the implication for others can be detrimental as well, when skills, technologies, artifacts, problem solving strategies and expertise are lost.

Indigenous knowledge is part of the lives of the rural poor**;** their livelihood depends almost entirely on specific skills and knowledge essential for their survival. Accordingly, for the development process, indigenous knowledge is of particular relevance for the following sectors and strategies:

- Agriculture
- Animal husbandry and ethnic veterinary medicine
- Use and management of natural resources
- Primary health care (PHC), preventive medicine and psychosocial care
- Saving and lending
- Community development

- Poverty alleviation

Indigenous knowledge is relevant on three levels for the development process. It is, obviously, most important for the local community in which the bearers of such knowledge live and produce.

Development agents (CBOs, NGOs, governments, donors, local leaders, and private sector initiatives) need to recognize it, value it and appreciate it in their interaction with the local communities. Before incorporating it in their approaches, they need to understand it – and critically validate it against the usefulness for their intended objectives.

Lastly, indigenous knowledge forms part of the global knowledge. In this context, it has a value and relevance in itself. Indigenous knowledge can be preserved, transferred, or adopted and adapted elsewhere.

The development process interacts with indigenous knowledge. When designing or implementing development programs or projects, three scenarios can be observed:

The development strategy either relies entirely or substantially on indigenous knowledge, overrides indigenous knowledge or, incorporates indigenous knowledge.

Planners and implementers need to decide which path to follow. Rational conclusions are based on determining whether indigenous knowledge would contribute to solve existing problems and achieving the intended objectives. In most cases, a careful amalgamation of indigenous and foreign knowledge would be most promising, leaving the choice, the rate and the degree of adoption and adaptation to the clients. Foreign knowledge does not necessarily mean modern technology, it includes also indigenous practices developed and applied under similar conditions elsewhere. These techniques are then likely to be adopted faster and applied more successfully. To foster such a transfer a sound understanding of indigenous knowledge is needed. This requires means for the capture and validation, as well as for the eventual exchange, transfer and dissemination of indigenous knowledge.

Role of science and technology:

Science, technology and innovation plays a critical role in enhancing economic growth and contributing to national development. It is the means by which new products and services are developed or improved and brought to the market. However, to make this contribution, science, technology and innovation must be integrated in the national development planning process. Over the years, the integration of science, technology and innovation in Uganda's national development planning has been implicit. Intentions to use science, technology and innovation as the vehicle for economic growth were evident in the country's comprehensive development framework such as the Poverty Eradication Action Plan (1997 – 2008/09) and the National Development Plan (2010/11-2014/15). However, strategies of how to use it to bring about the desired outcomes of economic growth were lacking.

Developments in science and technology are fundamentally altering the way people live, connect, communicate and transact, with profound effects on economic development. To promote tech advance, developing countries should invest in quality education

for youth, and continuous skills training for workers and managers.

Science and technology are key drivers to development, because technological and scientific revolutions underpin economic advances, improvements in health systems, education and infrastructure.

The technological revolutions of the 21st century are emerging from entirely new sectors, based on micro-processors, tele-communications, bio-technology and nano-technology. Products are transforming business practices across the economy, as well as the lives of all who have access to their effects. The most remarkable breakthroughs will come from the interaction of insights and applications arising when these technologies converge.

Through breakthroughs in health services and education, these technologies have the power to better the lives of poor people in developing countries. Eradicating malaria, a scourge of the African continent for centuries, is now possible. Cures for other diseases which are endemic in developing countries are also now possible, allowing people with debilitating conditions to live healthy and productive lives

Government is vigorously pursuing indigenous Research and Development (R&D) in various areas of Science and Technology (S&T) in the country. This has resulted a strong independent base in R&D and significant achievements have been made in the areas of agriculture, nuclear and space science, electronics, Information Technology (IT) and defence. Development of critical technologies in space sector such as indigenous cryogenic engine, air breathing propulsion, microwave remote sensing, deep space tracking antenna system etc. and reactor technology have demonstrated the focused directions of Indian research. Development of new affordable indigenous technologies for public health like vaccine for Japanese Encephalitis, test for molecular diagnosis of Thallassemia, test strips for diabetics, diagnosis kit for TB/H1N1 etc.; development of seed varieties and post harvest technologies for better management; indigenously developed drifter (Pradyu) with INSAT communication deployed in Bay of Bengal etc. are some fruitful results. India's performance in science sector is promising and impressive in recent years which are evident from the fact that India's position in research publications has improved from 10th position in 2006 to 9th position in 2010. India has emerged as the third major country in nano science and 5th in the world in Chemistry with respect to scientific publications.

Government has put in several systems to promote S&T in the country and create a scientific temperament among people. These measures include successive increase in plan allocations for Scientific Departments / Agencies, induction of new and attractive fellowships, strengthening infrastructure for R&D, encouraging public-private R&D partnerships, launching mission mode programmes *etc*. The space science missions including planetary missions, organizing National Level Exhibition and Project Competition under INSPIRE, running an exhibition train called 'Science Express', observing National Science Day, organizing regular national workshops etc. provide excellent opportunities in research for the

younger generations of the country and create scientific temperament and excitement among people.

Conclusion

Making or manufacturing of any product or service is not possible unless you know the science behind it. Product can be easily and cost effectively manufactured if it is known fully. This is possible only if it is designed and developed by self. If the science and technology in any product is indigenous then huge money will be saved towards intellectual Rights. The product suited to Indian needs can be designed and developed if indigenization is pressed more economically. Made in India will go hand in hand with science and technology for indigenous India and will give own identity in S&T and lead India as superpower and global leader.

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