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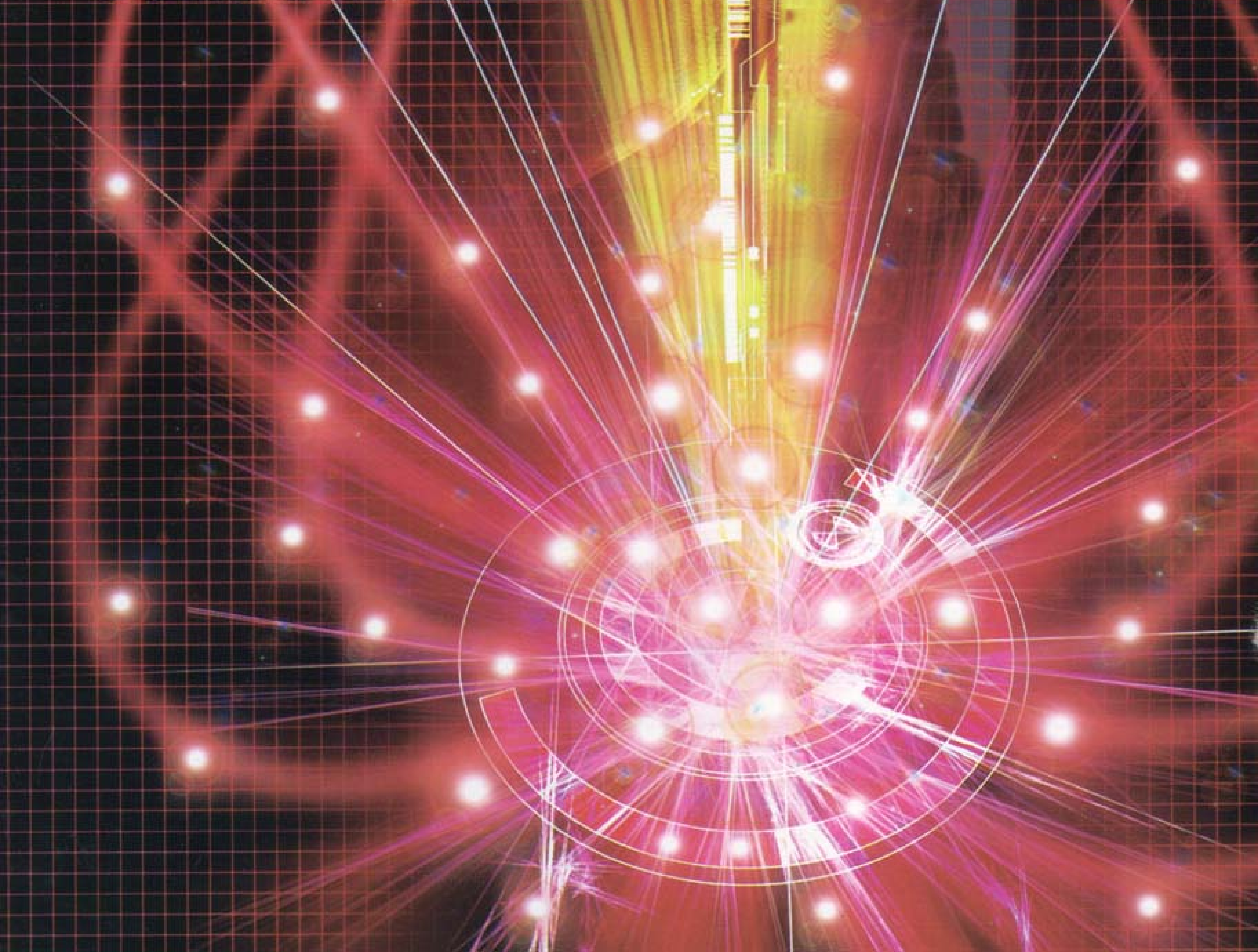

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Editorial

The Depth of Great Heights!

Nelson Mandela, the former President of South Africa once said that it is not AIDS that kills but poverty. Similarly, Anil Agrawal, a renowned environmentalist in India, said that it is not the earthquake that kills but buildings. The message is evident; awareness is the answer to risk. It may also be recognised that there is a continuing need to evaluate the efficacy of a particular system or activity and recognise 'best practices' to be adopted in particular context, be it regional or otherwise, to overcome social, regional and other inequalities. Apart from modern scientific knowledge, the world possesses centuries' old proven indigenous knowledge systems which cannot be disregarded while planning and implementing science communication programmes. It is with this objective, that India's National Institute of Science Communication & Information Resources (NISCAIR) has developed and maintaining a Traditional Knowledge Digital Library (TKDL), which has proved vital in protecting Indian IPR in case of cancellation of US patents of the remedial use of turmeric and basmati rice.

In developing countries, modern science and technology seem to have potential for addressing the pressing needs of improved nutrition, potable drinking water, public health, safety, and shelter. People in general are inquisitive of latest scientific concepts and technological developments, but what we lack is its popular, attractive, lucid and catchy presentation to non-experts. A whole host of activities and programmes has been observed which are available through government, non-government; voluntary, private, foreign, multinational and international sectors. Though, it requires much more concerted efforts to serve the public especially children better in terms of regular feed of popular science communication. The major competitors of science coverage in mass media as experts believe are : news and news based programmes (political, crime, sports or business), films / entertainment and now religious and superstitious programmes (on TV channels), whereas science always remains in backseat getting almost insignificant attention. This situation can be changed by way of making our products (print features, radio / TV programmes, other science communication activities) more competitive and saleable as compared to these earlier mentioned potential rivals. Nobody relishes a science story unless it is interwoven with the journalistic fabric of cuts and curls, packed certainly with startling and authentic facts, but also flavoured with spicy examples and presented with vibrant dynamism. We must stop blaming these so called most sought after subjects in the media and start making our science communication stuff more competitive and attractive; and here lies the real challenge before the science communicators that we must accept honestly.

The focus in this field is often on three kinds of science literacy : practical, civic, and cultural. In the developed world, debates about topics such as nuclear power or genetically modified foods are common and developing countries need to develop the mechanism for having such public debates on scientific subjects involving people's participation and enabling them make rational decisions especially when it comes to scientific issues confronting their day-to-day life. On the contrary science still remains an alien subject for common man in developing world. Even scientists have difference of opinion about likely ill effects of genetically modified crops as emerged in a two days workshop for journalists on bio-safety recently held earlier at Indian National Science Academy in New Delhi. Awareness of basic issues like providing potable water, health and hygiene, conservation of energy could be the priority areas for science communicators in the developing world. Also what is also to be emphasized is producing a science piece or programme which is interlaced with the sure ingredients of entertainment and interest. ●

Manoj Patairiya

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Technical Task Force : A Pilot Project of Agricultural Science Communication in China

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Abstract

China is an agricultural country with 63.91% of its total population living in rural areas. Low level of science literacy of Chinese farmers has considerably hindered productivity in the agriculture sector. As a consequence, the farmers are still poor, so it is crucial for Chinese farmers to learn modern agricultural methods in order to eliminate poverty. However, due to insufficient qualified personnel and lack of technical services, urgent needs of the farmers are not met. While agricultural technicians are locally available in large numbers, their knowledge has not been fully applied in agricultural practices; thus a big information gap exists between technicians and farmers. Therefore a proper communication channel and a cooperative guarantee system need to be established so as to pass on science and technology (S&T) information from the 'rich region' to the 'needy region'. With this background, a pilot project of agricultural science communication has been launched.

Based on 'Voluntary Registration & Mutual Selection', lots of technicians were hired by the local government as 'Technical Task Force (TTF)'. They lived and worked together with the local farmers. In their cooperative efforts they made technological as well as capital investment and share profits and losses to achieve 'double win' and then they both become shareholders. This pilot project is so successful in persuading Chinese farmers to use modern scientific methods, that the government is expanding it across the whole country. So far this project has been tried and practiced in 267 counties across 23 provinces in China. This paper attempts to analyse the working mechanism of this innovative project and discuss the relationships amongst local governments, farmers and TTF. The aim is to elaborate on an effective and successful practice of agricultural science communication between technicians and farmers in developing countries.

सारांश

चीन कृषि प्रधान देश है जिसकी 63.91 प्रतिशत जनसंख्या ग्रामीण क्षेत्रों में रहती है। वैज्ञानिक साक्षरता का निम्न स्तर बहुत हद तक कृषि क्षेत्र की कम उत्पादकता का जिम्मेदार रहा है। नतीजा, चीन का किसान अब भी गरीब है। अत: यह महत्वपूर्ण है कि किसान कृषि के आधुनिक तरीके अपनाएं ताकि गरीबी को जीता जा सके। हालांकि, तकनीकी रूप से दक्ष कर्मियों और तकनीकी सेवाओं की कमी के कारण किसानों की आकस्मिक जानकारियों की पूर्ति नहीं हो पाती। यदि तकनीकी कार्यकर्त्ता उचित संख्या में पास-पड़ोस में ही उपलब्ध हैं भी, तो भी उनके ज्ञान का इस्तेमाल कृषि कार्यों में नहीं हो पाता, और जानकारियों की खाई बरकरार है। अत: उचित संचार माध्यम और सहकारी प्रतिबद्धता का तंत्र स्थापित किया जाना आवश्यक है ताकि कृषि विज्ञान और तकनीकी का ज्ञान 'सुलभ क्षेत्रों' से 'जरूरतमंद क्षेत्रों' तक पहुंचाया जा सके। इस पृष्ठभूमि के साथ कृषि विज्ञान संचार को लेकर एक मार्गदर्शी परियोजना शुरू की गई है।

'स्वैच्छिक पंजीकरण और परस्पर चयन' के आधार पर स्थानीय सरकारों द्वारा अनेकों तकनीकी कर्मियों का एक 'तकनीकी कार्य दल' बनाया गया है। ये लोग स्थानीय किसानों के बीच रहे और कार्य किया। इनके सहकारी प्रयासों में इन्होंने तकनीकी व पूंजीगत निवेश किए और लाभ व हानि को बांटते हुए सफलता प्राप्त की। यह मार्गदर्शी परियोजना किसानों को आधुनिक कृषि ज्ञान बांटने में सफल साबित हुई है। अभी तक चीन के 23 राज्यों के 267 काउन्टियों में यह परियोजना लागू हो चुकी है। यह पत्र इस नवोन्मेषी परियोजना की कार्यपद्धति का विश्लेषण कर स्थानीय सरकारों, किसानों व कार्य दल के बीच के संबधों पर टिप्पणी करता है। तकनीकी-कर्मियों व किसानों के सहयोग द्वारा कृषि-विज्ञान संचार की ऐसी प्रभावी एवं सफल परियोजना को रेखांकित करने का भी यह एक उद्देश्य है।

Keywords : Technical Task Force (TTF), Pilot project, Agricultural science communication

Introduction

Science communication refers to the process of sharing S&T information among different partners. The purpose is to transfer the 'private knowledge' to 'public knowledge' domain thereby balancing the distribution of the information. It is quite normal that an information gap exits between the communicator and the receiver. Therefore a proper communication channel and a cooperative guarantee system need to be established to realise the effective distribution of the information resources.

China is an agricultural country with 63.91% of its total population living in rural areas[1]. In 2004, the average annual net income of a Chinese farmer was $363.13. They are still poor when compared to people in cities with the average net income of $1165.33[2]. Now traditional agriculture being gradually replaced by modern agriculture, Chinese farmers are weak in acquiring and applying the new technology. Their low science literacy (0.7%3) has considerably hindered the productivity in the agriculture sector. It is crucial for Chinese farmers to learn modern agricultural methods so they can eliminate poverty. Insufficient qualified personnel and technical services cannot meet the urgent needs of the farmers. Due to the fact that a large number of agriculture technicians are kept in agricultural colleges, graduate schools and local governments, their knowledge has not been fully applied in agricultural practices. This has created a huge gulf between present agricultural innovation institutes and those who apply these technologies - namely the farmers. A proper communication channel and a cooperative guarantee system need to be established in order to pass on S&T information from the 'rich region' to the 'needy region' and realise the main task of the agricultural science communication.

Background of Technical Task Force Project

For many years, Chinese government has been extending agriculture technology as a public welfare measure. As China's economic system has been shifting from the planned economy to market economy, the traditional agriculture is also evolving to a modern one, but S&T extension system is lacking. The stagnancy in selling the agricultural products has become the most troublesome issue for Chinese farmers. Productivity in the Chinese agricultural sector is low. For this reason, it is very difficult for Chinese agriculture to move forward.

In 1999 the local government of Nan-Ping County in Fujian Province considering the needs of the local farmers, hired 255 technicians in its rural areas consisting of 215 villages, based on the principle of 'Voluntary Registrations and Mutual Selection'.

During their stay in the rural region, these technicians made use of their own specialties to provide direct technological aids to the local farmers. They lived and worked together with the local farmers and made technological as well as capital investments in their cooperative efforts. They shared the profits and losses to achieve a 'double win' strategy. They were called the Technical Task Force (TTF). Through directly joining in the funding, they themselves became shareholders and thus built up a multiple-formed 'Interest Community' with farmers. By these means, a new model for agricultural science communication came into being. The fire for pursuing prosperity has been lit in the poverty stricken areas of Southeastern China.

The farmers have warmly welcomed TTF, as it has achieved a remarkable success. In Nang-Ping County the gross output value rose from $750 million in 1998 to $1,256 million in 2002. The average annual net income per farmer rose by 8.2%, twice as much as that of the whole Fu-Jian Province[4]. The society took notice of the 'Nan-Ping Phenomenon'. Other provinces were showing great interest in this project and the central government also thought highly of the work done in Nan-Ping. On December 31, 2004, Ministry of Science and Technology of China decided to spread this project across the whole nation. Up to now, 267 counties in 23 provinces have started TTF Project[5].

Interest Community - the core of TTF Project

TTF Project has developed a brand new economic model for Chinese agriculture, which accounts for its success. A mutual 'Interest Community' is established between the TTF and farmers, who both shared the profits as well as the risks. Market oriented management is practiced. As the case of the TTF Project conducted in Liao City demonstrates, it is an effective model for developing modern agriculture.

Liao City, in Shandong Province, is a city heavily relying on agriculture and can serve as a typical example of a large number of such cities in China. Farmers account for 80% of its total population. It is the first experimental city of the province to carry out the TTF Project. Starting in 2004, Liao City finds its own way out in practicing the Project, forming a trinitarian body of 'TTF+Farmer+Company'. The case of Liao City shows that the TTF Project has been efficient and effective.

Six patterns of the 'Interest Community'

To take Liao City as an example, six patterns of the 'Interest Community' can be summarised as follows :

1. **Model of building Demonstration Park :** The TTF, being partners and shareholders, funds and builds a Demonstration Park or manages the Demonstration Park under contract. Then they introduce new crops and apply new technology into practice. They thus set up examples for the farmers living in those nearby villages.

2. **Model of technology paid-service :** The TTF cooperates with the farmers by supplying technological service and get paid accordingly.

3. **Model of financial investing :** The TTF invests with the farmers to establish economical entities and get their dividends as rewards.
4. **Model of setting up S&T Agency :** The TTF helps the farmers and cooperate with them by introducing new agricultural technology or providing agent service. They are provided with a certain amount of the profit as rewards.
5. **Gratuitous pattern :** The TTF provides technological aids to the farmers for free.
6. **Reverse Contract Model :** The TTF takes a patch of land under contract on which they grow crops or set up poultry farms. And then they rent the land to the farmers. They also supply technical instruction and charge the farmers for their service.

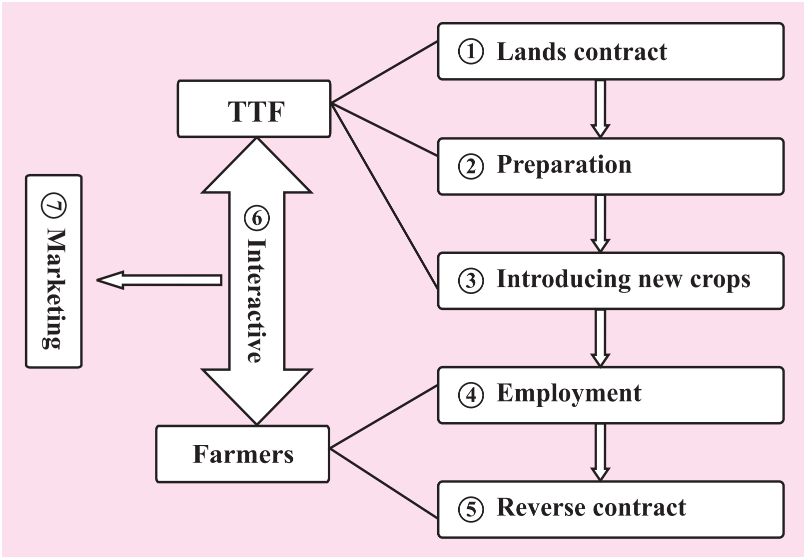

Figure 1: Seven steps in the 'Reverse Contract Model'

By means of the above six 'Interest Community' patterns, the TTF and the farmers share the profits as well as the risks. The enthusiasm of TTF is stimulated and motivated, and at the same time, the farmers' trust in the new technology is also enhanced. All this has contributed to productivity and efficiency. A large number of technicians are encouraged to work in the countryside.

Deconstruct 'Interest Community'- Reverse Contract Model.

Now I would like to elaborate more on the 'Reverse Contract Model' in order to present the process of science communication under 'Interest Community'. The 'Reverse Contract Model' as a seven-step procedure, is illustrated in the following figure :

1. Lands Contract : TTF takes a piece of land under contract from the local county (for example, deserted sandy land which bears little harvest). The general fee is \$7.26 per mu (i.e. 667m^2), and the contract usually holds for as upto 30 years.

2. Preparation : TTF raises funds, build the infrastructure and make the preparations. For example, they scarify the lands, drill wells for irrigation, build work sheds, set up electrical wires and even plant windbreaks.

3. Introducing new crops : TTF introduces new high quality crops and build a Demonstration Park / Demonstration Base. They plant fruit trees or grow new crops and try to attract the attention of the farmers with the new technology. Thus they make the demonstration park a model for the local farmers to learn from.

4. Employment : Farmers work in the demonstration park as employees. TTF teaches them how to do the planting using scientific methods. The farmers experience the process and see the profits of the demonstration park with their own eyes.

5. Reverse contract : Reverse to 'land contract' the farmers rent the lands from TTF under contract. Being given the technical instruction from TTF, farmers raise fund and manage the production by themselves.

6. Interactive : TTF provide their suggestions on production and management periodically. They train the farmers and give their instructions in fields. They also take the farmers out of their county to visit other successful farms to learn more.

7. Marketing : TTF invest and set up their own company to develop their own market. With TTF taking charge of marketing, farmers are exempt from the trouble of managing selling.

Up to November in 2005, in Liao City, 1,215 TTF found their way into rural villages. 207 Interest Communities have been set up; 211 professional associations are founded; 34,000 farmer' families are involved; 741 types of new technology are spread; 827 new farming species are introduced; 327 agricultural programs are implemented[6]. As a whole, S&T has been successfully transformed into productivity and greatly increased the yield on the farm and the income of the farmers.

The communication process of 'Interest Community'

The process of communication consists of five elements, namely communicator, content, channel, receiver and the feedback. According to the deconstruction of 'Reverse Contract Model', if the above seven steps are analysed in terms of communication theories, conclusions can be drawn as follows :

Communicator – TTF

The TTF is a representation of innovation. They are those who spread new technology. Being the specialists equipped with technology and management skills, the TTF communicates face-to-face with the farmers. They provide relevant instruction and share with the farmers their personal experiences. They clarify the farmers' doubts or questions in time and get the feedbacks. Most of TTF are local people so that they are rather familiar with the local situations and they have a lot commons with the farmers. As a consequence, farmers are more likely to trust them, and then the communication of new technology becomes possible and easier.

Receiver – Farmers

They receive the new scientific knowledge and the technology. Although the farmers in general have low scientific literacy and are weak in accepting and applying the technology, they have a strong desire to increase their income and possess a strong motivation to work with TTF.

Channel – Demonstration Park

It is the place where TTF extend the new technology to the farmers and where interactive communication between TTF and farmers takes place; especially where farmers make their own decision to learn new knowledge and adopt new technology.

Feedback – Associations

The TTF founded kinds of associations and they take in farmers as members. The association organises and gives lectures constantly to give technological instructions to farmers. Whenever the farmers have problems, they can come to the association for consultation.

It can be seen from above that the TTF extend the new technology to the farmers through the process of communication. In this process farmers make their own decisions to learn new knowledge and adopt new agricultural technology.

An innovation communication / diffusion

Diffusion is the 'process by which an innovation is communicated through certain channels over a period of time among the members of a social system'. An innovation is 'an idea, practice, or object that is perceived to be new by an individual or other unit of adoption'. Communication is 'a process in which participants create and share information with one another to reach a mutual understanding' (E.M. Rogers, 1995)[7]. The innovation communication / diffusion consists of five stages : knowledge, persuasion, decision, implementation, and confirmation[8]. Now the process of an innovation communication / diffusion, as shown in Figure 2 is explained below.

Knowledge : In the first place, the farmers are employed in the Demonstration Park as workers. They get to learn relevant technological knowledge, such as planting, cultivation or application of new tools. Farmers are thus given an opportunity to experience the power of S&T.

Persuasion : The TTF tries to persuade the farmers to adopt new technology or cultivate new crops.

Decision : The farmers make a decision of their own to rent the lands from TTF under contract and plant the new crops, applying the new technology they've acquired previously.

Implementation : The farmers manage the farming following the directions from TTF.

Confirmation : The demonstration park brings great profits. Consequently, more farmers will also show interest in planting new crops and applying new technology. Technological innovation therefore succeeds in its spreading to a wider extent.

To sum up, the analysis above shows that TTF Project is a new approach of science communication and of innovation communication in agriculture. It is transferring the traditional top-down one-way expansion organised under the administrative power into a two-way communication between TTF and the farmers. The farmers are no longer passive receivers; they experience the charm of science first; then learn to how to use it and finally they manage their farms by the new technology and make the profits along with TTF.

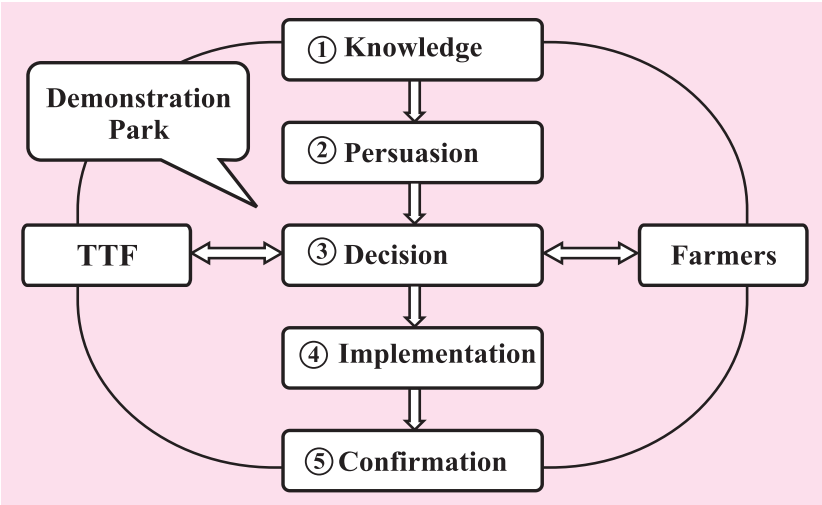

Figure 2: An innovation communication model of TTF Project

In this way, it not only enhances enthusiasm for the communicator and the receiver, but also gives the time for the farmers to digest and decide. This Project emphasises the advantage of interpersonal / local communication, especially based on the mutual interest between the communicator and the receiver.

Evaluation

When a system is to be evaluated, a key point is to figure out whether it will bring long term benefits. For a long time, the Chinese government and the relevant administrative sectors have been making efforts to develop effective programs to expand S&T to the local Chinese villages; 'Technology Expansion Caravan' is one of the examples. These activities have helped the farmers; however, the rate of application of new technology is still low. Furthermore, most specialists are unable to provide services for the farmers in remote regions, and therefore a vast number of farmers cannot obtain due training. TTF Project, however, could change such a situation and bring about positive effects.

First, it contributes to an increase of the peasants' income, and thus their living conditions can be considerably improved.

Second, scale land management helps enhance the agricultural productivity, which compensates for the lack of labour force.

Third, the introduction of new types of crops and the adoption of new technology elevate the level of scientific value in agricultural economy. The science literacy of the peasants is enhanced as well.

Fourth, the teaching as well as verbal instruction from TTF, the training in the association and the practice in the Demonstration Park serve as a good educational chance for the poor-informed peasants. This also makes up for an insufficiency of vocational education and technical training in rural regions.

Fifth, The TTF brings the science research outcomes directly to the villages and to the peasants. Thus it shortens the length of the time for applying scientific research findings.

In short, The TTF solves the problems of technology and marketing. Following the directions given by TTF, the peasants are on the right track to become rich together with TTF. Just like what TTF proposed, 'We show to the peasants, work with the peasants, and earn with the peasants'.

Experiences and obstacles

In a real Chinese situation, TTF Project is a successful pilot case of agricultural science communication. It altered the current training or consultation program into an Interest Community model, which is expected to improve the economic situation in rural regions. It also differs from those short term activities to spread technological knowledge to peasants; instead, it intends to change the short term programs into long term Projects.

Experience proves that TTF can and will demonstrate their special advantage in the work of science popularisation. They set an excellent example for science communicators. Their core principles are summarised as follows :

First, the employment of TTF is based on the principle of 'Voluntary Registration, Mutual Selection'. This improves the efficiency of human resource allocation. The former administrative order did not in fact take the peasants' needs into consideration. The technicians' special skills failed to be fully brought into play. By mutual selection, a better cooperation between the two parts can be found. So can be the allocation of resources.

Second, a guarantee system ensures that the title, occupation and salary will be reserved for TTF. The allocation of salary and title will not be delayed. All these measures make TTF feel willing to work hard for the Project without any reservation.

Third, a reward system is set up. TTF, who makes a prominent contribution will be rewarded or get promotion. In this way, the enthusiasm of TTF is greatly aroused.

Fourth, a credit card system is conducted for TTF to solve their shortage of funding

Fifth, a special college is established for TTF to hold lectures to improve their practical ability. It is also a platform for TTF to communicate information as well as share resources.

In a word, TTF Project proves to be highly effective. Due to the fact that it is still on the beginning stage, some obstacles and deficiencies still exist. TTF faces a serious shortage of funding. Lack of funding severely hinders the expansion of the cooperative scale and the increased interest. Moreover, a long-term workable mechanism for the Project is still not set up. And the Project also lacks an effective evaluation system.

Summary

In order to develop into a 'well-off society', it is essential for China, to help farmers prosper, increase their income and eventually develop agriculture industry. Chinese people have been working hard for years to make these goals come true. From the case study of TTF Project in Liao City, we can see that TTF Project is devised to achieve poverty elimination.

The case study in Lao City indicates that TTF Project is a workable model in building China's 'New Villages'. Thus it is promising to extend this model to more rural regions. The case of TTF Project is also a breakthrough in the course of science popularisation. Its strategies can be promoted, learned, and shared on opportune occasions for science and technology communicators not only in other regions of China, but also elsewhere.

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Challenges and Prospects of Science Communication in South Asia

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Abstract

SAARC (South Asian Association for Regional Cooperation) countries live in various layers, such as social, cultural, political, religious, scientific, economical, and natural. The bilateral and multilateral sharing, exchange, interaction and communication between these layers can mark a turning point of the process of overall development of the region. Public communication of science and technology could be crucial and vital in this regard. Though, there exist a variety of programmes and activities for taking science to masses and inculcating a scientific bent of mind into them, generally, it was observed that all these layers are working in isolation and there is hardly any interaction. The present study discovers a range of modes and means of science communication prevalent in these countries and tries to identify some common threads to make them more interactive and communicative to each other. By this they can also reap the power of scientific knowledge and scientific wisdom. It emerged that science communication through various media, be it print, broadcast, digital, folk or interactive in developing countries, especially in SAARC region, i.e., Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri-Lanka deserves much more serious efforts to be able to enhance their abysmally low level of scientific literacy, eradicate superstitions, and achieve a baseline public understanding of science. It is high time to draw advantages from the programmes like Sixth Framework of the European Union especially meant for scientific cooperation (including science communication) between EU and developing countries. A close interaction and communication between these layers would make them more responsive to each other, paving the way to develop better understanding and cooperation leading to sustainable development.

सारांश

दक्षेस (दक्षिण एशियाई क्षेत्रीय सहयोग संघ) के देशों में जीवन अनेक सतहों में विद्यमान है, यथा– सामाजिक, सांस्कृतिक, राजनीतिक, धार्मिक, वैज्ञानिक, आर्थिक व प्राकृतिक। इन सतहों के बीच आपस में विचारों व जानकारियों का परस्पर आदान–प्रदान, विनिमय व संचार इस क्षेत्र के विकास में मील का पत्थर साबित हो सकता है। विज्ञान एवं प्रौद्योगिकी का संचार इस दिशा में अत्यंत महत्व रखता है। हालांकि अनेकों तरह के कार्यक्रम व गतिविधियां विज्ञान के आम जन तक प्रचार व प्रसार में अग्रसर हैं और समाज में वैज्ञानिक प्रवृत्ति के प्रसार में लगे हैं तब भी ये देखा गया है कि सामाजिक सतहें ये अपने–अपने दायरे के अन्दर ही इस काम में लगे हैं और इनमें आपस में परस्पर कोई संवाद बहुत कम है। यह अध्ययन इन देशों में विज्ञान संचार के तरीकों व माध्यमों की खोज–पड़ताल करते हुए कुछ समान बिन्दुओं की पहचान करता है ताकि आपसी आदान–प्रदान का लाभ उठाया जा सके। वैज्ञानिक ज्ञान का इस प्रकार पूरा लाभ प्राप्त किया जा सकता है। यह स्पष्ट होता है कि दक्षेस देशों को अपने यहां की निम्न वैज्ञानिक साक्षरता बढ़ाने, अंध विश्वासों को मिटाने व न्यूनतम वैज्ञानिक समझ विकसित करने हेतु विभिन्न माध्यमों, मुद्रित, प्रसारण, सांख्य, लोक या बातचीत के माध्यम, द्वारा बहुत कुछ करने की आवश्यकता है। यह उचित समय है जबकि यूरोपीय संघ के छठे फ्रेमवर्क की तरह विज्ञान संचार समेत वैज्ञानिक सहयोग से लाभ उठाया जाए। विज्ञान को लेकर विभिन्न सामाजिक सतहों के बीच परस्पर आदान–प्रदान व सहयोग इमें बेहतर समझ पैदाकर टिकाऊ विकास का मार्ग प्रशस्त करेगा।

Key words: SAARC region, Science communication, Regional cooperation, Science literacy.

Introduction

South Asian Association for Regional Cooperation (SAARC) is now a progressive entity in the Indian sub continent and the forum has ample potential for enforcing desired changes here. SAARC region is blessed with treasure of natural resources, traditional knowledge, scientific and cultural heritage. The modern age of globalisation is witnessing rapid exchange of knowledge and information across the world, essentiality exchange of scientific knowledge and wisdom not only within the nations but also beyond the territorial boundaries. This cross-border culture of sharing scientific information and developing cooperation for the activities concerning Public Communication of Science & Technology (PCST) is yet to take shape in SAARC region. Though there have emerged a few potential indicators that clearly confirm the progressive trend of enhanced understanding; desire and efforts towards developing the region as a scientifically informed society. It would pave the way for enhanced mutual cooperation at bilateral as well as multilateral level and benefiting from the each other's experiences in the area of PCST.

A detailed study of literature, visits to various media and S&T organisations and interviews with pioneering science communicators have revealed a variety of science communication and popularisation activities in the region ranging from popular science writing and publications to street plays and planetariums. However, one can easily observe author's bias in this paper as India emerged as home to a broad range and variety of science communication activities as compared to other SAARC countries, but in order to give a picture in totality, it was unavoidable.

Observations

Many scholars believe that India's approach to the public understanding of science has been equally relevant to the needs of neighbouring countries as there are many, traditional and cultural similarities. India and Pakistan approach science communication with different objectives. Pakistan has adopted the much discussed 'deficit model' of public communication of science and technology, which focuses on helping people to acquire more knowledge of modern S&T developments. Most of the science popularisation programmes in Pakistan are similar to those of developed countries, such as science museums, planetariums, and mobile exhibitions, etc., targeting mainly the literate audience. Whereas, India has adopted a more indigenous approach incorporating 'participatory model' along with the above approach, which suits our needs. A planetarium may be useful in the European countries where the climate is generally cloudy, but in India, on the other hand, we have clear sky during nights for almost entire year, except a few rainy days. Therefore, children are encouraged to build their own telescopes, while they also undergo hands son experience of grinding a mirror for making a telescope thereby providing a chance for innovative ideas.

Coping with superstitions and miss-beliefs : The problem of communicating science in SAARC countries is mainly associated with strong religious faiths of the people in general. Science communicators in these countries generally avoid raising issues they believe may bring them into conflict with religious beliefs. For example, on the event of so called milk miracle (idols of Gods and Goddesses drinking milk) in 1995, the author was authorised by the Department of Science & Technology to investigate and report it back to the media. Then author investigated the phenomenon besides a team of scientists and reported the scientific explanation of the event on TV and issued a press release. The phenomenon now had scientific explanation as a result, but the author had received a number of threats from various fundamentalists.

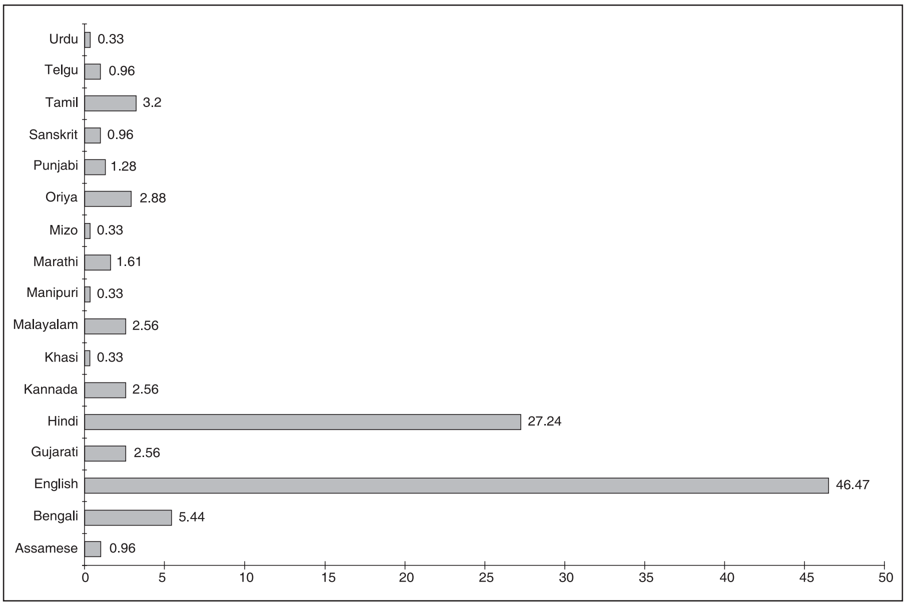
It is also true in Pakistan, Bangladesh and Maldives, being Muslim dominated societies, where human evolution is rarely discussed in public. Surprisingly, during a visit to India, Prof. Perves Amirali Hoodbhoy, a nuclear scientist from Pakistan and UNESCO's Kaling Award winner for public interpretation of science for 2003 revealed that in Pakistan, a very interesting project was proposed. There was a proposal to capture 'evil spirits (Jinn)' with the help of 'magic lamp' or through some other religious means to solve the energy crisis of the country. A PTV programme executive while covering the issue of cloning had to take extra care that the network may not be misunderstood to be promoting the idea of cloning.

Scientific explanation of so called miracles is a most popular and successful programme in India. Some 150 so called miracles prevalent in the country have been collected and scientifically explained to the people in far flung areas through groups of trained volunteers resulting into eradication of miss-beliefs amongst masses. Sri Lanka, as a contrast, has a programme for finding scientific reasoning of prevalent customs, beliefs and traditions and maintaining and restoring them.

It has been generally believed that science popularisation movement has been left behind in developing countries, but the present study clearly indicates that the developing world is now taking up public awareness of science in a big way and has started practical measures needed to address this and obviously India is considered a leader with her basket full of science communication activities and programmes that are well planned and orchestrated. Though, it may take longer time and efforts to eradicate centuries old misbeliefs and superstitions and achieve a baseline science for all.

Science journalism and role of mass media : Science communication in Pakistan and Bangladesh is the continuation of the process which began before partition of Pakistan and Bnagladesh from India in 1947 and from Pakistan in 1972 respectively. The first popular science magazine in Urdu was *Sa'ins* (Science) started in 1928 by Anjuman Taraqqi-e Urdu in Delhi.

It was discontinued in 1946 and resumed publication in 1952 from Karachi, but by 1954 it ceased to exist. The Scientific Society of Pakistan launched *Jadeed Sa'ins* (Modern Science), which continued till 1998. The Pakistan Council for Scientific and Industrial Research launched *Karwan-e Sa'ins* (Science Caravan), edited by Azmat Ali Khan, in 1964. The Council also launched two other popular science magazines, *Science Chronicle* (English) and *Vigyan Prakrati* (Bangla), published from Dhaka, then East Pakistan (now Bangladesh). Other popular science magazines in Pakistan included bimonthly *Sa'ins Bachchon Kay Liye* (Science for Children), which was published from 1972 to 1991, monthly *Amali Sa'ins* (Practical Science), 1971, *Sa'ins Digest* (Science Digest), 1981-2001, monthly *Talib-e Ilm* (The Student), 1985-1995 (renamed *Sa'ins Magazine* in 1987 and became weekly in 1988, but soon resumed as monthly), *Dunya-e Sa'ins* (Science World), 1988-1991, *Global Sa'ins* (Global Science), 1998-till date, with a circulation of 65,000; and *Urdu Sa'ins Magazine*, quarterly, 2002-till date. The country sees regular launches and closure of science magazines after a short existence with a few exceptions.



Popular Science Magazines in Regional Languages

Bangladesh Council of Scientific & Industrial Research (BCSIR) publishes a quarterly news bulletin titled *Sangbad Parikrama*, containing news on social, scientific and technological events, reports of meeting, seminar, symposium, workshop, innovation, processes, etc., are circulated to news media, government agencies, radio, television, and individuals. Pakistan Council of Scientific & Industrial Research (PCSIR) since its inception in 1955 has been publishing *Pakistan Journal of Scientific and Industrial Research*. In 1966 East Regional Laboratories, Dhaka started publishing *Scientific Research*, a quarterly research journal from Dhaka. Of late, after independence Bangladesh, the journal was titled as *Bangladesh Journal of Scientific & Industrial Research*. In order to promote public understanding of science and technology among common man, two periodicals *'Purogami Biggan' and 'Bigganer Joyjatra'* are being published in Bangla since early 1960s.

The problems understood by science communicators are : lack of government support, both financial and policy related as the public communication of science is treated as non-developmental; science remains merely a pedagogical affair belonging to the classroom; less support to address a wider audience; industry avoids advertising in science magazines; almost no academic courses available on science journalism / communication; no financial support to popular science magazines by the government; and scientists associate any importance to science popularisation. Although recently established National Commission on Biotechnology recognises enhancing public understanding of biotechnology as an essential activity and Pakistan Science Foundation is bestowed with the responsibility of science popularisation in that country. This situation contrasts with that of India, where the government encourages popular science journals by providing grants.

The situation in other SAARC countries like Nepal also needs to be improved. They continue to treat science with fear, without even realising the reason for it, as if they equated it with disaster. The first ever Science Popularisation Project (SPP) was established in Nepal in 1985 by a group of science enthusiasts, with the aim to turn ordinary people into scientifically literate. The project also paved the way to introduce science in the existing mass media such as newspapers, radio and television. A fortnightly feature service continued under the project for over five years, two training workshops on science journalism were organised in 1986 but with no headway. Out of some 2700 registered newspapers, there is almost no full time employed science communicator. The broadcast media also suffers from the same perils. In general, science is seen as a very difficult, complicated, boring and dry subject by and large across the world so as in SAARC region.

Science communication and science journalism may be a passion for those who enjoy and practice it with self driven enthusiasm but for the editors and publishers what matters is sensationalism because that is what sells. For example, a marked interest shown by ordinary public in defence science and technology; media tend to devote much space to nuclear issues. Editions of Pakistan's monthly Urdu magazine *Global Science* with focus on defence or nuclear matters outsell those on other topics. The challenge lies with making science news more interesting and palatable to suit comprehension by the lay public.

Recognising outstanding efforts in science communication : Professor Perves Amirali Hoodbhoy, a nuclear physicist from Pakistan, has been awarded with the UNESCO's Kalinga Prize for popularisation of science for the year 2003. The recipient was also awarded the Kalinga Chair, introduced by the Government of India in 2001 to mark the 50th anniversary of the Kalinga Prize. As an awardee of the Kalinga Chair, Prof. Hoodbhoy traveled to India for a period of four weeks as a guest of the Government of India and delivered popular science lectures at different places. The Kalinga Prize, an international recognition in the area of public interpretation of science, was established in 1951 with funds given to UNESCO by Biju Patnayak, a former Chief Minister of Orissa, an eastern province of India. Since its inception, four Indians and one Pakistani in the region have been awarded Kalinga Prize - Jagjit Singh (1963); Narender K. Sehgal (1991, jointly with Radu Iftimovici of Romania); Jayant V. Narlikar (1996, jointly with Jiri Grygar of Czech Republic), Dorairajan Balasubramanian (1997), and Perves Amirali Hoodbhoy (2003). The author has received an international award for advancement of science communication in the region by Centre for Global Studies, USA (2003). Arthur C. Clark, an acclaimed science fiction writer, has won a number of awards and recognitions for his mammoth work.

India offers a number of awards, recognitions and fellowships at national level to honour and encourage talented science communicators and science journalists through National Council for Science & Technology Communication, Indian National Science Academy, Indian Science Congress Association and Indian Science Writers' Association. In addition, some provinces have their own awards for such efforts. No information was found about such awards from other SAARC countries.

Human resource development : Science communication or science journalism is perhaps a well-established subject of academics in many developed countries, but in several developing countries it is still an alien and SAARC region is no exception. India however, has a well planned training programme for human resource development and training in the area of science communication and science journalism that is being successfully implemented since the beginning of the 1990s. The programme offers courses at 5 levels suitable to various target groups depending upon their qualifications and requirements : i) Short term courses, 1-2 weeks; ii) Medium term courses, 1-6 months; iii) Long term courses leading to degree, diploma, post graduation, 1-2 years; iv) Special / compulsory / optional paper as part of postgraduate courses on journalism and mass communication; and v) Correspondence courses, 1 year. There is hardly any information of such courses in other SAARC countries. In Nepal, attempts to establish a full-fledged science journalism course was made but with no success as yet.

Here comes the role of international organisations such as International Network on Public Communication of Science & Technology (PCST Network), European Union of Science Journalists' Associations (EUSJA), World Federation of Science Journalists (WFSJ), United Nations Educational Scientific and Cultural Organisation (UNESCO), South Asia Association for Regional Cooperation (SAARC), IDRC, DIFD, Welcome Group, US-NSF, Science and Development Network (SciDevNet) and 6th Framework Programme of European Commission on S&T Cooperation with Developing Countries to organise and support training programmes for the region in the region on various aspects of science communication and science journalism suitable to our needs. The western training modules may not work in totality and have to be indigenised sufficiently within the social and cultural milieu of the region and India's experience could be an advantage in this direction. Simultaneously, opportunities may be created to offer short term / long term training for potential science communicators and science journalists from developing countries to train abroad and scholarships / fellowships be introduced for formal training enabling them to get acquainted with the relevant knowledge and skill; who would eventually contribute to the quality and quantity of this profession in their native country. The SAARC Secretariat in association with Pakistan Science Foundation had organised a workshop for training the trainers in science popularisation involving science communicators from member countries in 1998 and it was resolved that organisation of such events would continue but there is no progress since then.

Another training workshop on science communication for Southeast Asia and South Asia was organised in 2005 by a network of scientists of LOICZ (www.loicz.org) addressing key issues of coastal change and coastal use including reclamation and urbanisation. The training workshop on effective science communication was to help change societal paradigms and to make science to be more relevant in day-to-day public affairs. Through the network of researchers and newly trained science communicators in the region, the scientific results can be disseminated more effectively to scientists, resource managers, community groups, environmentalists and broader audiences at various levels in the region. Sri Lanka Environmental Journalists Forum (SLEJF) is a network of environmental journalists in Sri Lanka, which offers media training and a number of publications in English, Sinhalese and Tamil including handbooks and guides to environmental reporting. COSTED has organised several training workshops on popular science writing and science journalism. As part of its capacity building role in science journalism, SciDev.Net hosts occasional science journalism workshops and training courses in the region. There is also an e-guide to science communication available on the site that contains practical advice, opinion and analysis and regional contacts for South Asia science journalists and communicators.

Generally, scientists and journalists are expected to write or communicate science to masses with an assumption that scientist knows science and journalist knows communication. There is no doubt about it. But unexpectedly, a scientist prefers to give much attention to his research work and write research papers with a 'very few' exceptions who prefer to write science for popular consumption. Likewise, a mainstream journalist generally prefers to report some scoop or sensational story with a 'very few' exceptions who prefer to write on science. And most of us start blaming both of them for not complying with our expectations. Here comes a science communicator into picture who could be trained in a way to work between both of them - between science and media. He or she could be a scientist interested in communication or a journalist interested in science or a science enthusiast, be it a teacher, a student, a bank official or a doctor or any one and every one who has got an aptitude towards science and its communication to masses. This set of science enthusiasts could be trained for the purpose and let us stop blaming scientists and journalists for not supporting science communication. If they come on board, they are welcome! Though, we must continue motivating them for taking up science communication partly.

Science communication research : Research and development is the backbone of any discipline and is must for its advancement. A variety of research projects have been conducted in India, such as, science coverage in print media (Hindi and English, 1989), job potential for science communication postgraduates (1990), public understanding of science at 'Sangam' (1995, 2001, 2005), impediments to scientific temper (1991), minimum science for all (1990), and science coverage in print and broadcast media (Gujarati, 1998), etc. A half-yearly international research journal titled *'Indian Journal of Science Communication (IJSC)'* is being brought out since 2001 carrying research findings on various aspects of science communication from all over the world. The journal commissions short term research projects which are capable of developing a research paper worth publishing in the journal. Besides these efforts, doctoral and postdoctoral research in science communication has also been started in some universities in India. The idea is to make science communication process more effective and competitive. There has so far been hardly any report of science communication research from other member countries.

Networking science communication : Networking science communication in the region is whose cup of tea any way? There is an emerging need for networking of organisations and individuals interested in science communication in the region to further the cause of science communication, may be at intergovernmental or voluntary level. There are proposals to form an Indo-European Science Communication Forum and / or South Asian Science Communication Forum to foster the science communication activities in the region and have joint programmes involving experts, journalists and scholars from member countries. The author wishes to reinforce the idea of establishing an international institution responsible for multiple objectives of science communication ranging from training, research and academics to publications and networking of science communication software, hardware and human ware and India has started spade work towards that. Incidentally, India, Pakistan, Nepal and Sri Lanka reported to have their respective science / environment writers' / journalists' associations that could be a great resource for regional networking of like minded people thereby preparing the land for convincing and influencing the governments, media and scientists to take necessary measures for the advancement of science communication that is vital for not only academic assimilation but also for overall development and a logical attitude. A manual or handbook for science communicators could also be published in English and be translated in regional languages.

Science communication campaigns : A variety of science campaigns have been employed over the years in the region. Beginning with Bharat Jan Vigyan Jatha (BJVJ-1987) in India, some countries had different types of science campaigns to reach to the masses with varied magnitude in terms of reach and efficacy. Science communication is a major activity of Royal Nepal Academy of Science & Technology (RONAST), which has been promoting public understanding of science and technology in Nepal. It organises various promotional activities such as science exhibition, science quizs and Olympiads, essay competitions and science teachers' workshops since its inception in 1982. It also encourages schools to take initiative in organising such programs, especially in rural areas. The campaign aimed at inculcating scientific temperament and growing scientific culture has covered direct participation of over 30 districts, besides Kathmandu valley. The other objectives include: to increase public awareness of science and technology in their daily life; enabling schools to develop simple science kits and demonstrate scientific phenomenon using locally available materials. Recently, science popularisation activities were organised as part of Science Fairs, which is generally tied up with local cultural and sports events to attract school children and general public at large. The activities included: Science exhibition, quiz, oratorical contest, essay competition, science teachers' workshop, lecture, and public interaction. The Bangladesh Council of Scientific & Industrial Research (BCSIR) has a public relations section from the beginning. The activities included: social relation of scientists with the public, government, other organisations, foreign countries, and UN bodies, and publication of booklets, leaflet on various scientific discoveries and innovations.

Districts covered by science fair activities since 1982

Other outreach programmes : India has a number of outreach programmes for different target groups from teachers and students to rural and tribal folks and those who are illiterate or neo-literate, such as science communication through folk forms, digital media and hands on activities like popularisation of HAM Radio, origami and astronomy. Bangladesh also has programmes for popularising HAM Radio and astronomy. The National Science Foundation (NSF) of Sri Lanka has its own way to popularise science among people with a bearing on social progress and national development. Its programmes are aimed at : creating knowledge based society that understands basics of current science and technology and its effective utilisation in daily activities, and understanding science and technology behind various traditional beliefs, customs and practices which may lead to renew or reinforce such traditions, as a contrast to India's programme against superstitions and misbeliefs. A wide gap between scientific community and society needs to be bridged. Accordingly, public understanding of science programme has been initiated under the theme 'Science for All' with the objective of making people scientifically literate who can appreciate the value of method of science. The NSF has various activities to its credit : NSF science magazine on TV, publication of *Vidurava* magazine, registration of school science societies, training of communication skills to scientists, science writers and media persons, science centres for general public, publication of science book series, workshops on scientific writing, celebrating World Science Day, and production of interactive CDs.

Discussion and Analysis

In developing countries, especially in SAARC region, modern science and technology seem to have potential for addressing the pressing needs of improved nutrition, potable drinking water, public health, safety, and shelter, it also emerged in a two days workshop, Achieving Public Understanding of Research in Developing Countries held in Cape Town, South Africa, in December 2002. People in general are inquisitive of latest scientific concepts and technological developments, but what lacks is its popular, attractive, lucid and catchy presentation to non experts. A whole host of activities and programmes has been observed which are available through government, non government; voluntary, private, foreign, multinational and international sectors in the region. Though, it requires much more concerted efforts to serve the regional populace better in terms of science communication. The major competitors of science communication in mass media as has been observed are : political news, crime news, sports news, business news and now religious and superstitious programmes on TV channels, whereas science always remains in backseat getting almost negligible attention. This situation can be changed by way of making our products (print features, radio / TV programmes and other science communication activities) more competitive and sellable as compared to those obvious rivals. Nobody relishes a science story unless it is interwoven with the journalistic fabric of cuts and curls, packed with startling and authentic facts, flavoured with spicy examples and presented with vibrant dynamism. We must stop blaming these so called most sought after subjects in the media and start making our science communication stuff more competitive and presentable; here lies the real challenge before the science communicators that we must accept honestly.

The focus in this field is often on three kinds of science literacy : practical, civic, and cultural. In the developed world, debates about topics such as nuclear power or genetically modified foods are common and countries in SAARC region need to develop the mechanism for having such public debates on scientific subjects involving people's participation and enabling them make rational decisions especially when it comes to scientific issues confronting their life. Developed-world scientists tend to take it for granted that science is a fundamental part of modern culture as is music or art, but in contrast science still remains an alien subject for common man in developing world so as in the SAARC region. Even awareness of basic issues like providing clean drinking water, health and hygiene, and conservation of energy could be the priority areas for the region.

Nelson Mandela, Former President of South Africa once said that it is not AIDS that kills but poverty. Similarly, Anil Agrawal, a renowned environmentalist in India, said that it is not the earthquake that kills but buildings. The message is clear, more awareness, less risk. It may be reinforced that there is a continuing need to evaluate the efficacy of particular activities and recognise 'best practices' to be adopted and used in particular regional contexts to overcome social and regional inequalities. Apart from modern scientific knowledge, the region possesses centuries old proven indigenous knowledge systems which cannot be avoided while planning and implementing science communication programmes in the region. It is with this objective, India's National Institute of Science Communication & Information Resources (NISCAIR) has developed and maintaining a Traditional Knowledge Digital Library (TKDL), which has been proved vital in protecting Indian IPR in case of cancellation of US patents of the remedial use of turmeric and basmati rice.

Strategies / Recommendations

Based upon the observations and analysis of the data available through various sources on the subject, the following strategies and recommendations are suggested for better linkages and activities for further development of science communication and popularisation in the region :

1. Regional network must be developed for fast exchange of ideas and experience within the region. Besides, a proposed South Asia Science Communication Forum, international organisations like, PCST Network and WFSJ can think of creating their regional networks.
2. Regional languages should be given due importance for science communication at grass root level and scientific information be made available in regional languages.
3. Strengths and best practices of every state in a particular area of science communication may be identified and replicated in other states.

4. Governments should establish or support institutions to train science communicators and science writers / journalists / scientists being basic resource for any activity of science communication.
5. Our commitment to the goal of science communication may become a unifying source for all member states as far as science communication is concerned.
6. Science communication wing may be formed as part of SAARC S&T Committee.
7. Exchange programme may be devised for students, science communicators, scientists and journalists to visit and spend some time in other member states.
8. Regional science communication awards may be instituted to encourage talented science communicators in the region.
9. An annual event, like regional science festival or congress may be planned to be organised by rotation in member countries.
10. Joint regional training workshops on various aspects of science communication / science writing / science journalism may be organised on regular intervals. Support from governments of member states and international organisations may be harnessed for the purpose.

Conclusion

The recent agreement for S&T cooperation between some of the countries in the region could be treated as major milestones towards cooperation in PCST as well. A remarkable participation of cross-national scientists, journalists and science communicators in various PCST activities and programmes in the region has been noted in the recent past. Efforts are being made to run India's Vigyan Rail / Vigyan Mail (Science Train : An S&T Exhibition on Wheels) also in Pakistan and Bangladesh after its overwhelming success in India where it travelled to various destinations during 2004-2005 attracting millions of people. SciDevNet, a UK based science and development web network, has started its South Asia Regional Gateway (www.scidev.net/southasia) incorporating information on science and development subjects of the region, thereby offering stronger science communication. India's Annual National Science Communication Congress and National Children's Science Congress offer forums for participation and exchanging views and experiences of scholars and students interested in PCST. However, it may be the rosy side of the picture and still there are many more miles to go together to achieve the desired level of public understanding of science; the countries in the region have to come closer for the purpose. This is only a beginning! We may look forward for better cooperation in PCST activities in the SAARC region in the years to come.

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Effective Science Communication : Evaluation and Appropriation of Basic Principles

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Abstract

Science is a public property. Therefore, it should be accessible to the public. Much of S&T has been done and accumulated in the last a few centuries. But because of the complex technical nature of S&T, it is not a cup of tea of the masses. Scientists too are unable to communicate science in a publicly understandable language and format. People need S&T for solving their problems, and for development and prosperity. So there is dire need of communicating science. But science communication itself is being a multidisciplinary field of expertise, is a complicated job to do. Moreover, there are many problems, obstacles and barriers in the way of science communication and popularisation. Therefore, science communicators feel here perplexed and look forward for some basic guidelines or principles for communicating science, which can solve their practical problems. The principles presented here are hoped to prove valuable for science communicators for doing their job effectively and efficiently.

सारांश

विज्ञान समाज की सम्पत्ति है। अत: विज्ञान पर आमजन की पहुंच हो। पिछली सदियों में विज्ञान एवं तकनीकी का अपार संचय हुआ है। लेकिन इसकी कठिन प्रकृति ने इसे आम आदमी से दूर रखा है। विज्ञानकर्मी भी आम भाषा में इस ज्ञान का संचार करने में असमर्थ हैं। लोगों की मुश्किलों का हल विज्ञान एवं प्रौद्योगिकी में है अत: इसे संचारित करने की आवश्यकता है। पर यह जटिल कार्य है और इसमें बाधाएं भी कम नहीं है। विज्ञान संचार के कार्य में मुश्किलें व परेशानियां अपार हैं। जब विज्ञान संचारक उलझ जाता है, तो वह सिद्धांतों व दिशा निर्देशों की तरफ देखता है। इनसे उसे विज्ञान के संचार में सुविधा होती है और समाज को भी लाभ होता है। यहां उद्धृत ये सिद्धांत व दिशा निर्देश विज्ञान संचारकों की राह आसान बनाएंगे, ऐसी अपेक्षा है।

Keywords: Science communication, Science popularisation, Effectiveness, Fundamental principles

Introduction

Science in day to day life means following principles of logic and rationality in our living.

Man is always in search of truth. From the time immemorial, man has always trying to lead a life full of joy, happiness, comfort and harmony with nature. In fact, a blissful life. But to achieve this, man always faces challenges and problems from nature. And to overcome these challenges and problems, it was necessary to know and study the principles and laws of nature and to exploit these for the advancement of humanity. This necessity gave rise to the origin of science. Science is to help and support us for the attainment of happier, more joyous, more comfortable life, by overcoming our challenges and problems.

Today we have mountainous piles of science and applied science (i.e., technology) with us. In the last a few centuries, man has accumulated so much of science (technology included) that it grew to extent of unmanageability. This led to its branching into, sub-branches, sub-sub-branches and so on. And most of this S&T is lying locked in the research laboratories and libraries, research journals and technical books, and that's too in a highly complex and alien sounding technical language. Most of the S&T is in English along with its technical terminology. The language of S&T is known only to a specific scientific community and is not understandable by the general masses. Even the scientific community of one subject cannot understand the language of another subject. Due to these reasons, science is not reaching the masses and so has become unable to fulfill its basic objectives of rationality in human living.

Need for Science Communication

Because of the above mentioned reasons, in is now being emphasised that S&T being developed in the laboratories should be made available to the masses. S&T developments need to be appreciated or criticised and used by the masses. But the society has been divided into the science-rich and the science-deficient communities. As more and more science is being done, the gap between these two communities is ever widening. It is so because scientists are unable to communicate in a publicly understandable language and format. Public too is unable to understand the technical language of science. This has given rise to the need of science communication. Science communication generally means acquainting the masses with scientific knowledge for inculcating scientific temper. It is to spread scientific awareness among people. It is also to popularise science and make it available in a publicly understandable language through different media. Today, science communication has been established and accepted as a multidisciplinary branch of scientific expertise. Science communication has the power of solving certain immediate problems pervading in the society, which are only due to ignorance or lack of scientific knowledge and scientific temper. A problem is a situation, which we don't know how to handle. When we know how to handle a situation, it is no more a problem! Unfamiliarity bars us from handling the situation in a right way. Here, science communication can familiarise us with the situation and help solving the problem. It can enable the society live a scientific, rational life.

Need for Principles of Science Communication

Science communication is faced with problems like communicative competency, audience receptivity, cultural compatibility, linguistic and socio-cultural diversity, linguistic and socio-political barriers, how to communicate science effectively and efficiently, how to inculcate scientific temper among masses, etc. Mere conversion of technical science into popular science and its dissemination does not mean science communication. Society's needs, goals, problems, challenges, understandability, authenticity and credibility of science communication are also important. Selection of the right medium, format, style and language for science communication is also necessary. Human element, emotions, interest and entertainment are also to be considered. All these things make science communication a complicated process. Understanding the gravity of this problem in science communication and the urgent need for guidelines or principles for effective science communication, the author here has proposed 'Principles of Effective Science Communication.' It is hope that these principles will prove valuable for science communicators in overcoming the pervading problems in science communication and in fulfilling their urgent need for the same.

Principles of Effective Science Communication

1. Principle of Necessity

For effective communication of science, it should necessarily be directed towards the specific contemporary needs, goals, aims, objectives, problems and challenges of the audience (receiver).

If science communication does not fulfill this principle of necessity, then all efforts, even the best ones, will be wasted. It is a well known proverb that necessity is the mother of invention. Therefore, this necessity factor must be digged / searched out for effective science communication. Man by nature, is a very selfish creature. He is interested in doing only those things, which are necessary for him. So before communicating science, we must ask ourselves whether it is necessary or not? This will help saving much time, money, efforts and energy of both the communicator and the receiver. We must have a goal or problem before us, and all our efforts must be directed towards the achievement of the goal or the solution of the problem. The goal or problem may be development, awareness, education, modernisation, development of scientific temper, decision making, socio-cultural growth, environmental protection, social consensus about science, etc.

2. Principle of Conciseness

Only that and that much of science should be communicated, which is concise enough to fulfill the goal of communication, without overburdening the audience (receiver) with scientific information, data and knowledge.

Human communication is always directed towards fulfilment of a specific purpose or goal. If this purpose or goal is not fulfiled, then communication is not effective or successful. For the fulfilment of a specific purpose or goal, only concise and to the point information is needed. Unnecessary lengthy details and information and off-the-track information can confuse or overburden the audience and can derail the process of communication. E.g., say, malaria epidemic is spreading. And we want the people to protect themselves from mosquito bites. Then the important thing is the concise information about how to protect oneself from the mosquito bites, and not the biological details of mosquito or the clinical details of malaria. So conciseness of scientific information or knowledge should be given due consideration in communicating science to the masses.

3. Principle of Utility

Science communication must be useful and only that science receives attention from the audience, which is useful immediately or in near future for the audience.

Psychologically, man learns only those things, which are useful or of some use to him, or which he considers will be useful. E.g., a farmer of hilly areas may show great attention to 'how to harvest the rain water in hilly areas by using scientific techniques.' However, out of curiosity or for general awareness, he may be interested in knowing how rice is cultivated generally.

4. Principle of Authenticity

Only that science should be communicated, which is authentic, tested, verified and true.

Authenticity is a must in science communication. The science communicator must ascertain the authenticity of the scientific knowledge or information, before communicating it to the masses. The communicator must take it as his / her moral duty and responsibility. Because wrong, incorrect, untrue, mutated or unauthentic information can lead to dire consequences.

5. Principle of Interest

Only that science communication receives attention of the audience, which is interesting to them or in which they have an interest.

Interest plays a vital role in any communication. So for effective science communication, it must be presented in an interesting way or an interest must be created in the audience.

6. Principle of Cultural Compatibility

Science communication must be compatible with the cultural context of the audience (receiver).

There is a deep relationship between communication and culture. Both are intensely inter related. Communication models and ways differ cross culturally. Therefore, a culturally non compatible model of science communication may fail to convey its intended meaning or the meaning conveyed may differ from its intended meaning. In addition to communication models, each culture has a certain level or degree of science, whether one believes it or not. So only that and that much of science is to be communicated, which immediately fits and becomes compatible with that level or degree of science present in the culture of the audience. The otherwise non compatible science may lead to cultural conflict. So, for sustained and long term effects of science communication, the cultural compatibility must be given due consideration

Further, if the communicator and the receiver (audience) belong to the same cultural group having the same cultural context, then there is more effective communication. Because both of them have a grasp on the symbols, codes, signs, meanings, pronunciation styles and accent, etc., of the same culture. So when they communicate, there is a greater compatibility and understanding of the information and knowledge (science) shared. If the science communicator is of the same culture and speaks the same language, etc., then the receiver develops confidence and faith on the credibility of the communicator. Moreover, the relationship between the communicator and the receiver (which varies from culture to culture) is also important here. E.g., in western societies, both the communicator and the receiver are almost viewed as equals. But in the Indian cultural context, the communicator is considered as higher or superior than the receiver.

7. Principle of Motivation

Communication of science (science communication) should bring a change in the attitude of the audience from the non scientific to the scientific one and must motivate the audience to live in a scientific way.

To meet the two main objectives of science communication i.e.;

a) Scientific awareness among people and

b) Inculcation of scientific temper.

Motivation is a big tool. Only through the intelligent use of motivation, the less receptive or the non receptive people can be made receptive and the receptive ones can be made more receptive to successfully accept, absorb and use the scientific knowledge and information communicated to them. People can be motivated to give up the harmful, illogical, nonsystematic and nonscientific thinking, attitude and lifestyle by stating its harmful effects. Similarly, they can be prepared to think logically and scientifically.

8. Principle of Orientation

Science communication must be development oriented, its language, format, mode, medium or style must be audience oriented (not the communicator oriented) and ultimately it must be target or result oriented.

Communication is always directed towards a goal. Therefore, the science communicator must get feedback from the audience and see whether the pre determined target or the expected result is achieved or not. Hence, it should be target / result oriented.

9. Principle of Packaging

Science communication must be marketed and advertised in handsome and attractive packages.

In today's world of business, marketing and advertising, mere dissemination of scientific knowledge will not lead to the popularisation of science. Here just plain or nude written, oral or audio-visual communication of science won't be working very effectively.

Science should be packaged carefully as per the needs of the audience; and in the right format and style of communication, the right language and the right medium and in the right amount.

10. Principle of Simplification and Commonness

Science communication must lead to the simplification of the science in technical language and the commonness of the simplified science.

Term 'communication' is derived from the Latin verb 'communicare,' which means to make common, to share, to import, to transmit. In Hindi, 'common' means 'sadharana.' So science communication means making science common to all, i.e., 'sadharanikaran' of science. And the equivalent word for 'sadharanikaran' in English is 'simplification.'

Thus, science communication means simplification and commonness of science among people. Public has the right to know what the scientists are doing with science in their laboratories. But public cannot access science because of its highly complex and alien sounding technical language. Therefore, science needs to be simplified in a publicly understandable language. This simplification will lead to the commonness of science. And commonness of science will prevent the monopoly of scientists on science and public will be able to make an opinion about science, scientific investigations and research, etc.

Further, commonness of science and involvement of public opinion will prevent the wicked, greedy and selfish scientists from doing bad or dangerous science. Whether good or bad, science being a public property affects each and every man (directly or indirectly). E.g., be nuclear bomb or nuclear power plant, nuclear science affects general public. Be biological weapons or antibiotics, biological sciences affects the masses. So by the commonness of science, only good and beneficial science will be done. According to Bhattanayak "the essence of communication is to achieve commonness or oneness among the people" and hence that of science communication.

11. Principle of Receptibility

The effectiveness of science communication is directly proportional to the receptibility (mental, intellectual, linguistic and socio cultural) of the audience.

Here, receptibility means the internal willingness, preparedness and eagerness of the audience to know something about science.

It the audience is not receptive or not ready to receive the scientific knowledge and information, and then no science communication is possible. So the communicator should try to know the level of receptibility of the audience, before communicating science. If possible, then he should try to make the audience more receptive by tactful motivation and conditioning. Timeliness is also important here. If some particular scientific information is presently important for the audience, they are willing to receive it. Duration of science communication session is also important. Usually longer sessions are boring and the audience unreceptive.

12. Principle of Liberty

Science communication must lead to intellectual, social, economic, political and cultural liberty.

Ignorance brings bondage, and knowledge brings liberty. Scientifically ignorant people are intellectually bound to certain dogmas, myths, blind faiths and superstitions, which bring no economic growth but social, political and cultural slavery. An intellectually bound and closed mind can neither achieve liberty nor can safeguard his existing economic, social, political or cultural liberty. All these types of liberty affect each other. But the intellectual liberty is the most basic one. Through it, one can achieve all other liberties.

13. Principle of Human Element

For effective and successful science communication, the scientific knowledge and information must be polished with the bright colours of human element.

Human element in science communication fills life in the dry scientific knowledge and information, making it more interesting, acceptable and reliable for the general audience. Attentive audience can receive and absorb more information and knowledge. Human element creates interest, and interest maintains attention. Thus, science communication can be made interesting and attention catching by including and making effective use of human element.

14. Principle of Prosperity

Science moves in a direction of human prosperity and hence, science communication must bring prosperity to humanity.

Science is a human endeavour to logically interpret and study his environment (or nature) to acquire knowledge and familiarity with it. This enables man to harmonise with his environment and to utilise it effectively as per his needs and requirements. This effective utilisation of environment through scientific knowledge also leads to the development of technology. Technology is also aimed at human comfort and prosperity. All this brings more joy, more happiness, more comfort and more pleasure to humanity.

Thus science communication must familiarise the general public with their environment and enables them to utilise it effectively as per their needs and requirements. It must enable the public to utilise S&T for overall prosperity. Moreover, having scientific knowledge and striving for it, also brings intellectual pleasure. In fact, many scientists do science just for intellectual pleasure and fancy.

15. Principle of Intellectual Growth

Science communication should lead to the development of the cognitive potential and should lead to intellectual growth of man (the audience) and it should add to his limited fund of scientific ideas and information on the basis of which he can attempt to cope with his environment.

One of the main aims of science communication is to make public aware of the scientific knowledge available, scientific discoveries, inventions, etc. This leads to the growth of cognitive faculties. It broadens man's mental horizons. It adds to the intellectual dimensions and the knowledge of environment of the audience.

16. Principle of Entertainment

When science communication is sandwiched in between the slices (or elements) of entertainment, then the populace (audience) can easily acquire it consciously or subconsciously, knowingly or unknowingly.

Through entertainment science can be easily communicated to the populace without making them aware of the fact that they are under the trial of science communication. People may not be interested in the boring science. But everyone wants entertainment. People are generally busy in their day-to-day life. They usually pretend that they want to know / learn about science, but have no time and energy to invest in such an activity. For this, they give reasons of business or exhaustedness. But they always steal time (even from the tightest working schedules) for entertainment.

Hence, here is the point. Science communication through entertainment, but will also receive the inputs of science. And for this, we can exploit the popular means of entertainment like puppetry shows, street plays, theatre, fantasy, fiction, novels, poetry, drama, scientoons, newspapers, magazines, books, radio, TV, cinema, animations, internet, etc. Audio visual media (TV, cinema and internet) are the most effective ones, because their influence and coverage is much wider.

17. Stimulus Response Principle

Expression (communication) of science by the science communicators must stimulate the receiver to search for the meaning of the science communicated and as a result, the receiver must respond with better interpretation of the scientific information received.

Science communication stimulates the receiver about science and the receiver responds accordingly. Any organism's behaviour (including man) is mostly in response to the stimulus (stimuli) it receives from within or from outside. How a communicator presents science and how it affects, influences or manipulates the receiver, determines the behaviour or response of the receiver. If the stimulus is positive, the receiver shows positive response and vice versa. Science communication must stimulate the receiver to inculcate the scientific temper, to follow the scientific method of problem solving and to absorb the science communicated to him and responds with deeper understanding and self awareness of science.

18. Principle of Effectiveness

Science communication is said to be effective, if the desired goal, purpose or reaction / action from the audience is successfully achieved in the given limited time.

If it doesn't happen, then something is wrong with the product (message) of science communication, the communication technique or medium used or the audience.

As the communicative competency of the (science) communicator, transmission of science (message) through the medium or its interpretation by the receiver is never 100% effective and efficient. At least something is lost in the communicative process. Hence, the corollary to this principle is :

No communication of science is 100% effective and efficient in achieving its goal.

Further, no science communication can reach each and every member of a society or each and every member of audience can never receive the communicated science effectively. Hence, our efforts should be to achieve the maximum possible degree of effectiveness of science communication. Therefore, the second corollary to the principle of effectiveness is :

Science communication is never perfect, as no communication is.

19. Principle of Participation and Two way Communication

The receiver (audience) of science communication must actively participate in the communication process. That is, for effective science communication, the communicator and the receiver should behave and interact in a participatory way and ultimately enter in two way communication.

Through participatory or two way communication, we can effectively communicate science to the masses. Here, the audience can be judged or asked for feedback directly and simultaneously. Any problem can be discussed to the extent of satisfaction, i.e., audience's satisfaction. It is just like consumer satisfaction in business. Further, the communicator can adjust his message or communication as per the needs and the level of the audience. This makes the communication process inclusive, and not exclusive. It creates more interest in the audience. But for communication through mass media (radio, TV, cinema, etc.), all the audience cannot directly participate. However, they can unify or identify themselves with the receiver of communication in the medium. Thus, the receiver of mass media communication should represent the masses, and it should be powerful enough that the maximum possible audience can unify or identify themselves with it.

20. Principle of Repetition

Repetition reinforces the message of science communication and helps making stronger impressions on the mind of the receiver and subconsciously convinces the receiver to accept and absorb the message and hence, it can bring unexpected success to science communication.

Whatever man learns, learns mainly through repetition, repetition and repetition. Experience is also acquired through the repeated activity, behaviour, observations, happenings, occurrence of things and ideas, etc. A single exposure to some new information, idea or thing is rarely effective in learning or communication and in making long term memories. It has to be repeated. Repetition has such a magical power that it can make people to accept even the apparent lies as true. So why not to use it in science communication for the novel cause? The entire advertising industry is also based on the principle of repetition. Moreover, the success of the Polio Eradication Mission in India, can be genuinely credited to the excessive repetition of the polio vaccination messages by the great celebrities through the different media. Therefore, repetition can be a great boon to science communication, but no doubt, its affordability is a question.

Conclusion

These fundamental principles of effective science communication have been assumed to help understand better the process and problems pervading in science communication. These are also supposed to smoothen and make easier the job of science communicators. These are based on the multi disciplines of science, philosophy, art, psychology, education, communication, mass media, humanity, linguistics and sociology. So these are expected to increase the effectiveness of science communication and to bring out the best possible of it.

The principles cover the different aspects and problems of science communication to make it as successful, effective and efficient as possible. The science communicators are recommended to make full use of these fundamental principles to make their job more successful, effective and efficient. However, these principles do not ensure 100% successful, effective and efficient science communication, because no communication is perfectly effective. Still the best possible is expected.

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वैज्ञानिक शास्त्र एवं शब्दावली: अनुवाद की समस्याएं एवं समाधान

विश्वमोहन तिवारी

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भारतीय वैज्ञानिक शब्दावली की आवश्यकता

1. भारत में अंग्रेजों ने राजनैतिक विजय के बाद, उपनिवेश को सुदृढ़ बनाने के लिए जो तरीके अपनाए उनमें से तीन ने उन्हें सर्वाधिक लाभ पहुंचाया। एक तरीका था 'फूट डालो, दूसरा था भारतीय संस्कृति पर आक्रमण तथा तीसरा भारतीय भाषाओं का निष्कासन कर, अंग्रेजी को स्थापित करना। उनकी इस 'दूरदर्शिता' का परिणाम है कि आज देश में हम अपनी सहस्रों वर्ष पुरानी संस्कृति से कट गए हैं तथा भोगवाद अपने अमानवीय रूप से हमारे ऊपर छा गया है। हमारे मौलिक सृजन एवं चिन्तन में अवनति हुई है।

2. हमारी भाषा का औपनिवेशीकरण इतना अधिक हो गया है कि हम परिवार, माता, पिता, भाई, बहन, पत्नी, पुत्र, पुत्री, आजी (दादी), नानी आदि शब्दों के स्थान पर अंग्रेजी शब्दों का ही उपयोग करते हैं। विशेषकर ये सारे शब्द अपने साथ, केवल प्रत्यक्ष अर्थ न लेकर, पूरी संस्कृति लेकर चलते हैं। यह हमारी भावनात्मक ऊर्जा तो बढ़ाते ही हैं, हमारे अधिकारों तथा कर्तव्यों का भी अवचेतन में ही बोध करा देते हैं। क्या हम भोगवाद के साथ भावनाहीनता की तरफ बढ़ रहे हैं, तथा इसलिए भावनात्मक ऊर्जा से भरे शब्दों का भी बहिष्कार करते जा रहे हैं, यथा जन्म, मृत्यु, प्रेम, प्रसव, शिक्षक, शिष्य, समाज, भारत, आदि। ये शब्द भी हम अंग्रेजी में ही बोलते हैं। हमारे लिए भावनात्मक रूप से 'डैथ' या 'लव' बोलना आसान है मृत्यु या प्रेम बोलना कठिन क्योंकि मातृभाषा में ऐसे शब्द अधिक भावनापूर्ण होते हैं। इन भावनात्मक शब्दों को अंग्रेजी में बोलने के कारण हम भावहीन होते जा रहे हैं, हमारा कहीं रोबॉटीकरण हो रहा है! हम अमानवीय हो रहे हैं।

3. यह युग विज्ञान एवं प्रौद्योगिकी (विप्रौद्योगिकी) का है। बिना विप्रौद्योगिकी में आगे बढ़े कोई भी देश विकसित नहीं हो सकता - यह निर्विवाद सत्य है। अर्थात विश्व में विप्रौद्योगिकी में जो आधुनिक है उसका ज्ञान आवश्यक है। इसका अर्थ कुछ विद्वान निकालते हैं कि इस हेतु यदि संपूर्ण शिक्षा का नहीं तो विप्रौद्योगिकी शिक्षा माध्यम अंग्रेजी होना अनिवार्य है क्योंकि भारतीय भाषाओं में विप्रौद्योगिकी के लिए आवश्यक शब्दावली नहीं है। यह प्रचार भ्रामक है। सन् 47 तक डॉ. रघुवीर ने न केवल तैंतीस हजार वैज्ञानिक शब्द रच डाले थे, वरन उन्होंने सिद्ध कर दिया था संस्कृत-पुत्री हिन्दी में विप्रौद्योगिक शब्दों के निर्माण की शक्ति है जिसके द्वारा भविष्य में भी आवश्यक विप्रौद्योगिक शब्दावली का निर्माण किया जा सकता है और अद्यन्त विप्रौद्योगिक शास्त्र का या मौलिक लेखन या अनुवाद का निर्माण कार्य किया जा सकता है। सौभाग्य से भारत में भारतीयता प्रेमी विद्वान हैं जो अंग्रेजी में शिक्षित होने के बाद भी भारतीय भाषाओं में यह कार्य कर रहे हैं, और आगे भी करते रहेंगे।

4. तकनीकी शब्दावली न केवल हमारी तकनीकी भाषा का वरन् हमारी सामान्य भाषा का भी अनिवार्य अंग बनती जा रही है। यह युग विज्ञान-तकनीकी-प्रौद्योगिकी-संचार-माध्यम का तथा अंतरिक्ष का युग है। इस युग में यदि आप उदासीन नहीं हैं, तनिक भी आधुनिक हैं तब आप की भाषा में, विचार में, स्वप्नों में तकनीकी शब्द झील में कमल की तरह खिले रहते हैं। यदि भारत से भारतीय संस्कृति से प्रेम है तब वे तकनीकी शब्द अधिकांशत: आपकी मातृभाषा के संगीत से गुंजायमान रहेंगे न कि अंग्रेजी से।

5. भारत सरकार के विज्ञान एवं तकनीकी शब्दावली आयोग ने विज्ञान एवं तकनीकी शब्दकोषों का निर्माण किया है जिनमें लगभग पाँच लाख तकनीकी शब्द हैं। अपने आप में यह निश्चित रूप से बहुत ही महत्वपूर्ण एवं प्रशंसनीय कार्य है। (डॉ. रघुवीर के प्रयत्नों के बाद) यह इस दिशा में चूँकि पुरोगामी उद्यम है, इसलिए इसमें त्रुटियां तथा कमियां रहना स्वाभाविक है। साथ ही, चूँकि नये तकनीकी शब्द अंग्रेजी भाषा से आ रहे हैं इसलिए यह भी स्वाभाविक

है, कि उनके तुल्यार्थी शब्दों का निर्माण कार्य उनसे पीछे ही रहेगा। और एक बार जब अंग्रेजी शब्द ज़ुबान पर चढ़ जाते हैं तब वे उनके तुल्यार्थी देशज शब्दों को सरलता से स्थान नहीं देते। अतएव यदि हम मशीनीकरण, औपनिवेशीकरण तथा अमानवीयकरण से बचना चाहते हैं तब हममें नवीन तकनीकी शब्दों के निर्माणार्थ, प्रयोगार्थ, तथा संशोधनार्थ एक प्रकार की आकुलता होनी चाहिए। यह दुख की बात है कि ऐसी आकुलता कम दिखाई देती है। जैसे आज किसी भी देश को सम्मानपूर्वक जीवित रहने के लिए विप्रौद्योगिकी में सशक्त होना आवश्यक है, उसी तरह भारतीय भाषाओं को और इसलिए भारत की मानवीय संस्कृति को स्वतंत्र एवं मौलिक सोच को जीवित रखने के लिए विप्रौद्योगिक शब्दावली का समृद्ध होना आवश्यक है।

तकनीकी शब्दावली की समस्याएं एवं समाधान

6. विज्ञान एवं तकनीकी शब्दों का निर्माण कठिन कार्य है। विज्ञान तथा तकनीकी शब्दों के अर्थ सुनिश्चित होते हैं तथा अक्सर वे किसी अवधारणा का संप्रेषण अपने अर्थ में प्रकाशित करते हैं। पहले तो उस अवधारणा को सही तथा पूरा समझने वाला तथा उस विशिष्ट विज्ञान को समझने वाला ऐसा व्यक्ति चाहिए जो उस अवधारणा के लिए उपयुक्त शब्द भारतीय भाषा में ढूँढ़ सके या गढ़ सके, और यदि इतना न कर सके तो, कम से कम, भारतीय भाषा के किसी उपयुक्त विद्वान को वह अवधारणा सही रूप में समझा सके ताकि वह विद्वान उपयुक्त शब्द ढूंढ़ सके या गढ़ सके। अतएव कठिन शब्दों के अनुवादों में थोड़ी बहुत गलतियाँ मिल ही जाती हैं। उदाहरण के लिए उड़ान से संबंधित एक शब्द लें – 'लूं' ('या') जिसका अर्थ शब्दकोष में 'पार्श्ववर्तन' दिया गया है। इस संयुक्त शब्द से जो अर्थ निकलता है वह है बाजू में घूमाना या घूमना या मुड़ना या घूर्णन करना क्योंकि पार्श्व का अर्थ है बाजू तथा वर्तन का अर्थ है घूमना, मुड़ना या घूर्णन। किन्तु 'लूं' का सही अर्थ तीनों में से एक भी नहीं। शब्दकोष (ऑक्सफोर्ड) में जो अर्थ दिया है वह गलत तो नहीं है, अर्धसत्य है 'लूं' की क्रिया अर्थात् – "अल्प अवधि के लिए त्रुटिपूर्ण चालन के कारण अपनी सीधी दिशा से हट जाना" से वास्तविक लूं की क्रिया का कोई बोध नहीं होता। इस शब्द का सही अर्थ बनता है 'पार्श्वसर्पण' अर्थात अपने बाजू की दिशा अर्थात विमान के ही तल में बाजू (पार्श्व) की ओर खिसकना या खिसकाना (समर्पण) ऐसा पायलट द्वारा विमान की वर्तन या लोटन क्रिया के समय अधिकांशतया गलत नियंत्रण के कारण होता है।

7. एक और उदाहरण लें, शब्द है 'neutral particle'। परमाणुओं में धन विद्यतु (proton) तथा ऋण विद्युत (electron) कण होते हैं किन्तु उनकी विद्युत मात्रा बराबर होने के कारण उनका कुल आवेश शून्य होता है, अत: परमाणु को 'neutral particle' कहते हैं। यह संयुक्त शब्द शब्दावली आयोग के तकनीकी शब्द कोष में नहीं है। इस कोश में 'neutral' शब्द के तीन अर्थ दिये गये हैं – उदासीन, मध्यसिलिक तथा निष्प्रभावी। 'निष्प्रभावी कण' पद सही अर्थ का संप्रेषण न कर किसी प्रभाव के न होने का अर्थ देता है, जो स्पष्ट नहीं है। मध्यसिलिक शब्द भूगर्भशास्त्र के लिये उपयुक्त है। इन तीनों में से उदासीन शब्द ही यहां पर हमारी वांछित अवधारणा के कुछ निकट आता है, अर्थात शब्द बन सकता है – 'उदासीन कण'। किन्तु एक तो 'उदासीन' शब्द अपने साथ 'उदास-सी' भावनाएं भी लाता है जिनकी इस वैज्ञानिक परिवेश में आवश्यकता नहीं है। तथा दूसरे 'उदासीन' शब्द से हमारी अपेक्षित अवधारणा भी प्रकाश में नहीं आती। इसलिये सही शब्द होना चाहिए 'निरावेश कण'। निरावेश इसलिये और भी उपयुक्त है क्योंकि आवेश का तकनीकी अर्थ विद्युत 'चार्ज' ही है अतएव यह शब्द 'निरावेश कण' 'neutral particle' में जो अवधारणा है उसे मूल अंग्रेजी शब्द से भी अधिक स्पष्टता से प्रकाशित करता है।

8. इस दिशा में एक उदाहरण और लें। अंग्रेजी में शब्द है 'aeronautics'। यद्यपि कोश में 'aero' के लिये कोई शब्द नहीं दिया गया है, किन्तु 'aeronautic' के लिये 'वैमानिकी' दिया गया है। यह शब्द एकदम गलत तो नहीं है किन्तु पूरी अवधारणा को स्पष्ट नहीं करता है। विमान के अतिरिक्त भी यान हैं जो उड़ते हैं तथा गुब्बारे, रॉकैट आदि इन सबका अध्ययन, वैमानिकी में नहीं, किन्तु अंग्रेजी शब्द 'aeronautic' के अंतर्गत आता है। वैसे पंछियों की उड़ान के अध्ययन भी 'aeronautic' के अंतर्गत आ सकते हैं। अतएव अधिक सटीक शब्द हैं 'उड्डयनिकी' या 'उड़ानिकी'। 'वैमानिकी' के अर्थ को भिन्न प्रकार के विमानों, ग्लाइडरों, वायुपोतों, आदि, की भिन्न उड़ानों वाले शास्त्र के अध्ययन तक ही सीमित रखना चाहिये। ये उदाहरण शब्दों द्वारा उनमें निहित अवधारणाओं को आलोकित करने की सामर्थ्य की आवश्यकता को स्पष्ट करने के लिये दिये जा रहे हैं। वैसे तो शब्दों द्वारा आलोकित अवधारणा या अर्थ अन्तत: उनके उपयोग द्वारा ही संपुष्ट और प्रमाणित होती है।

9. शब्दावली की रचना में दूसरी आवश्यकता शब्दों के सरल होने तथा व्यावहारिक होने की है, कुछ व्यक्तियों द्वारा यह नियम अंग्रेजी भाषा के लिये नहीं वरन भारतीय भाषाओं पर काफी कड़ाई के साथ लागू किया जाता है। यद्यपि अंग्रेजी शब्द कठिन हो तब कोई बात नहीं। उदाहरणार्थ 'frequency division multiple access' में शब्दकोश का सहारा लेकर शब्द आता है – 'आवृत्ति विभाजन बहु

अभिगम' तो लगभग सभी एक साथ खड़े होकर अंगुली उठायेंगे और ऐसे कठिन शब्दों के उपयोग पर प्रतिबंध लगा देंगे। फिर कहेंगे कि इन्हीं कारणों से हिन्दी का प्रसार नहीं हो रहा है। वे पूछेंगे कि क्या आवृत्ति का विभाजन होता है? यह प्रश्न उन्होंने अंग्रेजी 'frequency division' के लिए नहीं किया था। जबकि अंग्रेजी की अपेक्षा हिन्दी में संस्कृत के प्रदाय के आधार पर 'समास' नामक संयुक्ताक्षरों की प्रक्रिया अधिक प्रचलित है। वे थोड़ा भी रुककर यह नहीं सोचते कि इस सामासिक शब्द का अर्थ 'आवृति के आधार पर विभाजन' भी हो सकता है।

10. शब्दावली आयोग के शब्दकोश में 'maintenance' का अर्थ दिया गया है – 'अनुरक्षण' तथा 'escort' का अर्थ भी दिया गया है 'अनुरक्षण'। एक तकनीकी शब्द से दो नितान्त भिन्न अवधारणाओं को अभिव्यक्त करना वांछनीय नहीं है। इसलिये मेरा सुझाव है कि escort के लिये उपयुक्त शब्द होगा 'परीक्षण'। अनु में पीछे या बाद की ध्वनि भी आती है यह ध्वनि 'परि' में नहीं आती, वरन 'परि' में चारों ओर की ध्वनि आती है जो 'escort' की सब तरफ से रक्षा करने वाली अवधारणा को बेहतर अभिव्यक्त करती है। अनुवादक का कार्य हमेशा कोई मशीन की तरह एक भाषा के शब्द के अर्थ को एक शब्दकोश की सहायता से बदलना नहीं है, वरन उस शब्द के मूल अर्थ को अपनी भाषा में अभिव्यक्त करने वाले शब्द का सृजन करना या खोजना है।

एक्रोनिम या प्रथमाक्षरी शब्दों की समस्या

11. एक और महत्वपूर्ण मुद्दा है 'acronym' या प्रथमाक्षरी नामों का। अंग्रेजी में प्रथमाक्षरी नाम धड़ल्ले से चलते हैं और हिन्दी में शायद ही, जबकि मराठी में भी खूब चलते हैं। ऐसे बहुत प्रथमाक्षरी वाले तकनीकी लेखों का जब भी हिन्दी में अनुवाद होगा, तब उस लेख में शेष पाठ तो हिन्दी में होगा और ये अंग्रेजी प्रथमाक्षरी शब्द उसमें 'हीरे' की तरह अंग्रेजी में ही जड़े होंगे। चूँकि हिन्दी में प्रथमाक्षरी नाम सरकारी हिन्दी में नहीं चलते इसलिये अंग्रेजी के तमाम प्रथमाक्षरी शब्दों ने हिन्दी पर कब्जा कर लिया है, जैसे 'Laser, Air Defence (AD), SLV (Satellite Launch Vehicle), PSLV (Polar Satellite Launch Vehicle)', आदि। क्यों न हम हिन्दी में प्रथमाक्षरी शब्द बनायें और उनका उपयोग धड़ल्ले से करें अन्यथा अंग्रेजी का हिन्दी पर कब्जा और बढ़ता ही जाएगा। हिन्दी में प्रथमाक्षरी शब्दों का उपयोग कठिन लगता है, और कभी कभी हास्यास्पद भी। किन्तु यदि प्रथमाक्षरी शब्द मराठी में खूब चलते हैं तो हिन्दी में भी चलेंगे। उदाहरण देखिए – 'LASER' इसका यदि अक्षरश: अनुवाद कर दें तो बनेगा प्र (काश) प्र (वर्धन) सं (प्ररित) उ (त्सर्जन) वि (किरण) (के द्वारा) अर्थात 'प्रप्रसंउवि' जिसका उच्चारण कठिन है। इसके स्थान पर प्र (काश का) वि (किरण के) सं (प्ररित) उ (त्सर्जन द्वारा) प्र (वर्धन) अर्थात 'प्रविसंउप्र' जो कि हिन्दी की प्रकृति के अधिक अनुकूल है। इसी तरह SLV का उ (पग्रह) प्र (मोचन) या (न), अर्थात 'उप्रया' बनता है, लेखक के विचार से 'उप्रयान' बेहतर होगा। तथा PSLV के लिए ध्रुउप्रयान या ध्रुव-उप्रयान बेहतर होगा। हम जितने जल्दी प्रथमाक्षरी शब्दों को अपने स्वभाव के अनुकूल कर, मानक बनाकर अपना लें, हिन्दी तथा भारतीय भाषाओं के लिये वह उतना ही श्रेयस्कर होगा।

कुछ अन्य विचारणीय तथ्य

12. चूँकि पाठक अंग्रेजी तथा हिन्दी अखबारों में 'frequency division multiple access' या इसी तरह के अन्य कठिन शब्द जब पढ़ते हैं, तब संदर्भ से उसकी अवधारणा को बिना शिकायत किये जैसी तैसी समझ लेते हैं और उससे थोड़ा सा परिचित हो जाते हैं इसलिये भी थोड़े समय बाद उन्हें यह शब्द अंग्रेजी में कठिन नहीं लगता और बेचारा हिन्दी का शब्द 'आवृत्ति विभाजन बहु अभिगम' हमारी हीन भावना के कारण जड़ हो जाता है।

13. शब्दावली के प्रसार प्रचार में वास्तविक समस्या है कि बनाये गये शब्दों के भंडार सब तक कैसे पहुंचे? शब्दावली आयोग शब्द गढ़ने का महती कार्य तो कर रहा है किन्तु उसके प्रसार-प्रचार का कार्य वांछित वेग से नहीं हो रहा। एक बात और पहले इनके द्वारा प्रकाशित शब्दकोशों की कीमत 'लागत' मूल्य से काफी कम रखी जाती थी। अब जब से खुला बाजार आया है तबसे लिपस्टिक, साबुनों की तरह ये महती समाज सेवा के कार्य भी उसके शिकंजे में आ गये हैं। अब 27,000 शब्दों वाले रक्षा शब्दकोश का (लागत के बराबर) मूल्य 284 रु. रखा गया है। और लगभग 36,000 शब्दों वाले 'Oxford Hindi English Dictionary' का मूल्य 295 रु. है जिस पर वे (प्रकाशक) पूरा लाभ भी बनाते है।

14. इस दिशा में एक सांस्कृतिक समस्या तब पैदा होती है जब हम प्रचलित भारतीय शब्दों के स्थान पर तुल्य अंग्रेजी शब्दों का उपयोग करते रहते हैं जिनके उपयोग करने की कतई आवश्यकता नहीं है। ये वे भारतीय शब्द हैं जिनका अंग्रेजी भक्षण कर रही है और भारतीय शब्दों के स्थान पर अपने शब्दों को लाकर एक गहरा उपनिवेश स्थापित कर रही है। माता, पिता, पत्नी आदि ऐसे शब्दों के कुछ उदाहरण तो पहले ही दिए गए हैं। हमारी हीन भावना के और उदाहरण यथा – डीडीए के मकानों के लिये एपार्टमैंट। 'एपार्टमैंट' का सीधा अर्थ फ्रैन्च तथा इतालवी में बड़े मकान से छोटे मकान को 'अलग करना' होता है, और मात्र उपयोग करते

करते उसमें प्रचलित अर्थ स्थापित हुआ है। इसलिये डीडीए आदि संस्थाओं ने यदि इसके स्थान पर 'प्रकोष्ठ' शब्द का उपयोग किया होता तो आज 'प्रकोष्ठ' ही प्रचलित होता। इसी तरह 'फेज' (क्रमांक), 'पॉकेट' (भाग), 'सैक्टर' (खंड) घुसपैठिये मजे से हिन्दी पर राज्य कर रहे हैं।

15. अंग्रेजी लोग आए हमें उपनिवेश बनाया, 200 वर्षों तक हमें, हमारी संस्कृति को कुचलते हुए राज्य किया और स्वतंत्रता आन्दोलन के परिणाम स्वरूप सन् 47 में चले गए। किन्तु अंग्रेजी द्वारा एक उपनिवेशीकरण 'विज्ञान तथा प्रौद्यौगिकी' के नाम से तो भारत में लगभग सौ वर्षों से चल रहा है, दूसरा उपनिवेशीकरण संचार माध्यम तथा मनोरंजन के नाम पर अभी अभी आया है किन्तु अल्पकाल में ही उसने अनपेक्षित अधिक सफलता प्राप्त की है। तीसरा उपनिव्ेाीकरण भी अंग्रेजी द्वारा उपनिवेश बनाने पर आरम्भ हुआ था – पक्षियों, पेड़-पौधों आदि में नामकरण तथा ज्ञान का अंग्रेजी में उपलब्ध कराया जाना। जब जापान ने कोरिया को अपना उपनिवेश बनाया था तब उन्होंने सोल के राजपथ के किनारे लगे कोरियाई वृक्षों को कटवाकर जापानी वृक्ष लगवा दिये थे। कोरिया ने स्वराज्य प्राप्त होने पर वापिस अपने वृक्ष लगवाए। यदि पंछियों, वृक्षों, पौधों के भारतीय नाम भी हम भूल गये तो हमारी गुलामी और सुदृढ़ होगी। प्रकृति प्रेम तथा साथ-साथ हमारी पर्यावरण-संरक्षण की जो पाश्चात्य की पर्यावरण संरक्षण से भी श्रेष्ठ सांस्कृतिक परम्परा है वह समाप्त हो जायेगी। यह भी एक गम्भीर समस्या है, अतएव इसे अधिक सूक्ष्मता से देखा जाए।

16. इस तरह हम देखते हैं कि वैज्ञानिक शास्त्र का निर्माण करने के लिये हिन्दी में उचित शब्दावली का अत्यंत महत्वपूर्ण स्थान है। ऐसा करने में अनेक समस्याएं आएंगी, किन्तु उनका समाधान भी किया जा सकता है। तथा इस सब चर्चा से दो तथ्य स्पष्ट हुए। पहला तो यह कि विज्ञान-प्रौद्योगिकी के नाम पर भी अंग्रेजी का उपनिवेशवाद पनप रहा है तथा माध्यम-मनोरंजन के नाम पर न केवल फलफूल रहा है वरन उसमें बहार आ गई है। दूसरा, विज्ञान-प्रौद्योगिकी से परे, जहां हमारे पास या तो शब्द भंडार हैं, या उनका ही विकास किया जा सकता है, वहां भी अंग्रेजी के उपनिवेशवाद का आना हमारी हीन भावना तथा हमारी संकुचित दृष्टि को उजागर कर एक श्रयानक भविष्य की ओर इंगित करता है कि जब न हमारी भाषा बचेगी और न संस्कृति जिसके परिणाम स्वरूप हमारे हृदय में मानवीयता के बचने का ही प्रश्न चिन्ह लग जायेगा। ■

Short Communication

Popularising Science : Avoiding Pitfalls

C. Shekhar Nambiar

It is an accepted fact that all knowledge is culture specific, although these are fundamental characteristics common to all human beings from the psychological and physiological perspectives. But since all human beings do not lie in the same natural and cultural environments the knowledge which different groups of people acquire and the actions they base on that knowledge, vary. We know that this knowledge and those actions are not static. This is particularly true of science and technology. Science communicators in the developing world especially in the South Asia region, are confronted with a tremendous challenge – faced as they are with problems of poverty, illiteracy, malnutrition, health, hygiene, unemployment, housing, environmental degradation and the increasing rural-urban divide.

The role of communication in changing people's lifestyle and attitudes cannot be underestimated. Communications experts and development communication theorists of alternative communication systems (interactive, computerised and dialogue systems) offer immense potential for improving the lot of the poor. But the new technologies of communication have to be delinked from centralised, monopolistic systems if they are expected to provide meaningful benefits to the people. It is also important that grassroot movements are encouraged with greater role for the people in the decision making process that affect their socioeconomic, political and cultural lives. Those involved in science and environment education and communications, therefore, must take a holistic view of, these aspects in a historical context.

The reasons for communicating science to the public range from considerations of culture to education, government to politics. At a time when resources are scarce, the public has the right to know how the money is spent by science and technology organisations and what benefits they can expect from projects by way of improved technology and better health. Achievements of many a scientific project do not come to the public notice as scientists rarely communicate. It is here that the role of media comes to the fore. The media has the responsibility of sharing scientific ideas and achievements with the public through their channels.

The social benefits of science popularisation in the media are immense. But, in countries such as India and Nepal, the diffusion of media outlets and regular users of media are low, given their literacy rate and purchasing power. Hence, the need for channels like interpersonal, educational, and combined channels of big and small media. Communicators must evaluate contemporary science in relation to contemporary problems and take into account the social and cultural environment as also the people's aspirations and needs.

While the pursuit of science and technology has, and will be, the privilege of a few, there can be no doubt that general awareness of it has to be universal. The face-to-face approach, or dialogue with the people, is one of the strategies adopted by many developing countries. The voluntary science movement started in Kerala in 1962 by the Kerala Sastra Sahitya Parishad illustrates how public understanding of science can be enhanced by grassroots participation. The movement has been able to involve the participation of scientists, science writers, teachers, and social workers in its activities which include publication of popular science books, magazines, health care, and adult (science) literary programmes. A 'science march' in 1977, with volunteers traversing over 10,000 km in 37 days, established contact with over 500,000 people through 900 public meetings. The movement has also largely been successful in campaigning for the preservation of the state's ecological resources and the environment.

In such an approach, care must be exercised by speakers and participants not to question established beliefs – religious, cultural or social. Only those concepts of science are to be elaborated which are of general interest – health, traditional and alternate systems of medicine, simple remedies to minor ailments and injuries such as snake bites, ecological preservation and energy conservation. This needs to be done through simple and lucid presentations.

Popular media such as folk theatre, dance and solo cultural performances are sometimes effective, for popularising science.

Although they offer a varied fare suitable to the region and culture of the place of their performance, there are, some inherent drawbacks in this approach, especially their unacceptability, by the youth. Besides, the performers owing to their lack of formal education may not always be able to convey compiled ideas in a simple manner. The use of traditional media for popularising science, therefore, has to be assessed carefully by appropriate feedback techniques from the people and the results properly documented for future reference and use.

(Source : National Herald)

UN Declaration on Science and the Use of Scientific Knowledge

Preamble

1. We all live on the same planet and are part of the biosphere. We have come to recognise that we are in a situation of increasing interdependence, and that our future is intrinsically linked to the preservation of the global life-support systems and to the survival of all forms of life. The nations and the scientists of the world are called upon to acknowledge the urgency of using knowledge from all fields of science in a responsible manner to address human needs and aspirations without misusing this knowledge. We seek active collaboration across all the fields of scientific endeavour, that is the natural sciences such as the physical, earth and biological sciences, the biomedical and engineering sciences, and the social and human sciences. While the 'Framework for Action' emphasises the promise and the dynamism of the natural sciences but also their potential adverse effects, and the need to understand their impact on and relations with society, the commitment to science, as well as the challenges and the responsibilities set out in this Declaration, pertain to all fields of the sciences. All cultures can contribute scientific knowledge of universal value. The sciences should be at the service of humanity as a whole, and should contribute to providing everyone with a deeper understanding of nature and society, a better quality of life and a sustainable and healthy environment for present and future generations.

2. Scientific knowledge has led to remarkable innovations that have been of great benefit to humankind. Life expectancy has increased strikingly, and cures have been discovered for many diseases. Agricultural output has risen significantly in many parts of the world to meet growing population needs. Technological developments and the use of new energy sources have created the opportunity to free humankind from arduous labour. They have also enabled the generation of an expanding and complex range of industrial products and processes. Technologies based on new methods of communication, information handling and computation have brought unprecedented opportunities and challenges for the scientific endeavour as well as for society at large. Steadily improving scientific knowledge on the origin, functions and evolution of the universe and of life provides humankind with conceptual and practical approaches that profoundly influence its conduct and prospects.

3. In addition to their demonstrable benefits the applications of scientific advances and the development and expansion of human activity have also led to environmental degradation and technological disasters, and have contributed to social imbalance or exclusion. As one example, scientific progress has made it possible to manufacture sophisticated weapons, including conventional weapons and weapons of mass destruction. There is now an opportunity to call for a reduction in the resources allocated to the development and manufacture of new weapons and to encourage the conversion, at least partially, of military production and research facilities to civilian use. The United Nations General Assembly has proclaimed the year 2000 as International Year for the Culture of Peace and the year 2001 as United Nations Year of Dialogue among Civilisations as steps towards a lasting peace; the scientific community, together with other sectors of society, can and should play an essential role in this process.

4. Today, whilst unprecedented advances in the sciences are foreseen, there is a need for a vigorous and informed democratic debate on the production and use of scientific knowledge. The scientific community and decision-makers should seek the strengthening of public trust and support for science

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Text adopted by the World Conference on Science, July 1, 1999; Definitive version through such a debate. Greater interdisciplinary efforts, involving both natural and social sciences, are a prerequisite for dealing with ethical, social, cultural, environmental, gender, economic and health issues. Enhancing the role of science for a more equitable, prosperous and sustainable world requires the long-term commitment of all stakeholders, public and private, through greater investment, the appropriate review of investment priorities, and the sharing of scientific knowledge.

5. Most of the benefits of science are unevenly distributed, as a result of structural asymmetries among countries, regions and social groups, and between the sexes. As scientific knowledge has become a crucial factor in the production of wealth, so its distribution has become more inequitable. What distinguishes the poor (be it people or countries) from the rich is not only that they have fewer assets, but also that they are largely excluded from the creation and the benefits of scientific knowledge.

6. We, participants in the *World Conference on Science for the Twenty-first Century* : *A New Commitment*, assembled in Budapest, Hungary, from June 26 to July 1, 1999 under the aegis of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council for Science (ICSU) :

Considering :

7. where the natural sciences stand today and where they are heading, what their social impact has been and what society expects from them,

8. that in the twenty first century science must become a shared asset benefiting all peoples on a basis of solidarity, that science is a powerful resource for understanding natural and social phenomena, and that its role promises to be even greater in the future as the growing complexity of the relationship between society and the environment is better understood,

9. the ever increasing need for scientific knowledge in public and private decision-making, including notably the influential role to be played by science in the formulation of policy and regulatory decisions,

10. that access to scientific knowledge for peaceful purposes from a very early age is part of the right to education belonging to all men and women, and that science education is essential for human development, for creating endogenous scientific capacity and for having active and informed citizens,

11. that scientific research and its applications may yield significant returns towards economic growth and sustainable human development, including poverty alleviation, and that the future of humankind will become more dependent on the equitable production, distribution and use of knowledge than ever before,

12. that scientific research is a major driving force in the field of health and social care and that greater use of scientific knowledge would considerably improve human health,

13. the current process of globalisation and the strategic role of scientific and technological knowledge within it,

14. the urgent need to reduce the gap between the developing and developed countries by improving scientific capacity and infrastructure in developing countries,

15. that the information and communication revolution offers new and more effective means of exchanging scientific knowledge and advancing education and research,

16. the importance for scientific research and education of full and open access to information and data belonging to the public domain,

17. the role played by the social sciences in the analysis of social transformations related to scientific and technological developments and the search for solutions to the problems generated in the process,

18. the recommendations of major conferences convened by the organisations of the United Nations system and others, and of the meetings associated with the World Conference on Science,

19. that scientific research and the use of scientific knowledge should respect human rights and the dignity of human beings, in accordance with the Universal Declaration of Human Rights and in the light of the Universal Declaration on the Human Genome and Human Rights,

20. that some applications of science can be detrimental to individuals and society, the environment and human health, possibly even threatening the continuing existence of the human species, and that the contribution of science is indispensable to the cause of peace and development, and to global safety and security,

21. that scientists with other major actors have a special responsibility for seeking to avert applications of science which are ethically wrong or have an adverse impact,

22. the need to practise and apply the sciences in line with appropriate ethical requirements developed on the basis of an enhanced public debate,

23. that the pursuit of science and the use of scientific knowledge should respect and maintain life in all its diversity, as well as the life-support systems of our planet,

24. that there is a historical imbalance in the participation of men and women in all science related activities,

25. that there are barriers which have precluded the full participation of other groups, of both sexes, including disabled people, indigenous peoples and ethnic minorities, hereafter referred to as disadvantaged groups,

26. that traditional and local knowledge systems, as dynamic expressions of perceiving and understanding the world, can make, and historically have made, a valuable contribution to science and technology, and that there is a need to preserve, protect, research and promote this cultural heritage and empirical knowledge,

27. that a new relationship between science and society is necessary to cope with such pressing global problems as poverty, environmental degradation, inadequate public health, and food and water security, in particular those associated with population growth,

28. the need for a strong commitment to science on the part of governments, civil society and the productive sector, as well as an equally strong commitment of scientists to the well-being of society,

Proclaim the following :

1. Science for knowledge; knowledge for progress

29. The inherent function of the scientific endeavour is to carry out a comprehensive and thorough inquiry into nature and society, leading to new knowledge. This new knowledge provides educational, cultural and intellectual enrichment and leads to technological advances and economic benefits. Promoting fundamental and problem oriented research is essential for achieving endogenous development and progress.

30. Governments, through national science policies and in acting as catalysts to facilitate interaction and communication between stakeholders, should give recognition to the key role of scientific research in the acquisition of knowledge, in the training of scientists and in the education of the public. Scientific research funded by the private sector has become a crucial factor for socio-economic development, but this cannot exclude the need for publicly-funded research. Both sectors should work in close collaboration and in a complementary manner in the financing of scientific research for long term goals.

2. Science for peace

31. The essence of scientific thinking is the ability to examine problems from different perspectives and seek explanations of natural and social phenomena, constantly submitted to critical analysis. Science thus relies on critical and free thinking, which is essential in a democratic world. The scientific community, sharing a long standing tradition that transcends nations, religions and ethnicity, should promote, as stated in the Constitution of UNESCO, the "intellectual and moral solidarity of mankind", which is the basis of a culture of peace. Worldwide cooperation among scientists makes a valuable and constructive contribution to global security and to the development of peaceful interactions between different nations, societies and cultures, and could give encouragement to further steps in disarmament, including nuclear disarmament.

32. Governments and society at large should be aware of the need to use natural and social sciences and technology as tools to address the root causes and impacts of conflict. Investment in scientific research which addresses them should be increased.

3. Science for development

33. Today, more than ever, science and its applications are indispensable for development. All levels of government and the private sector should provide enhanced support for building up an adequate and evenly distributed scientific and technological capacity through appropriate education and research programmes as an indispensable foundation for economic, social, cultural and environmentally sound development. This is particularly urgent for developing countries. Technological development requires a solid scientific basis and needs to be resolutely directed towards safe and clean production processes, greater

efficiency in resource use and more environmentally friendly products. Science and technology should also be resolutely directed towards prospects for better employment, improving competitiveness and social justice. Investment in science and technology aimed both at these objectives and at a better understanding and safeguarding of the planet's natural resource base, biodiversity and life support systems must be increased. The objective should be a move towards sustainable development strategies through the integration of economic, social, cultural and environmental dimensions.

34. Science education, in the broad sense, without discrimination and encompassing all levels and modalities, is a fundamental prerequisite for democracy and for ensuring sustainable development. In recent years, worldwide measures have been undertaken to promote basic education for all. It is essential that the fundamental role played by women in the application of scientific development to food production and health care be fully recognised, and efforts made to strengthen their understanding of scientific advances in these areas. It is on this platform that science education, communication and popularisation need to be built. Special attention still needs to be given to marginalised groups. It is more than ever necessary to develop and expand science literacy in all cultures and all sectors of society as well as reasoning ability and skills and an appreciation of ethical values, so as to improve public participation in decision-making related to the application of new knowledge. Progress in science makes the role of universities particularly important in the promotion and modernisation of science teaching and its coordination at all levels of education. In all countries, and in particular the developing countries, there is a need to strengthen scientific research in higher education, including postgraduate programmes, taking into account national priorities.

35. The building of scientific capacity should be supported by regional and international cooperation, to ensure both equitable development and the spread and utilisation of human creativity without discrimination of any kind against countries, groups or individuals. Cooperation between developed and developing countries should be carried out in conformity with the principles of full and open access to information, equity and mutual benefit. In all efforts of cooperation, diversity of traditions and cultures should be given due consideration. The developed world has a responsibility to enhance partnership activities in science with developing countries and countries in transition. Helping to

(Contd. on page 38)

SCIENTOON

PARASITOLOGY

Animals or plants which live in or on others and draw nutrients from them for their survival are called PARASITES.

Study of parasites is known as PARASITOLOGY

"See these scientists! They exploit us for publishing research papers, getting Ph.D., attending seminars, visiting abroad and still they call us parasite?"

First India Science Report

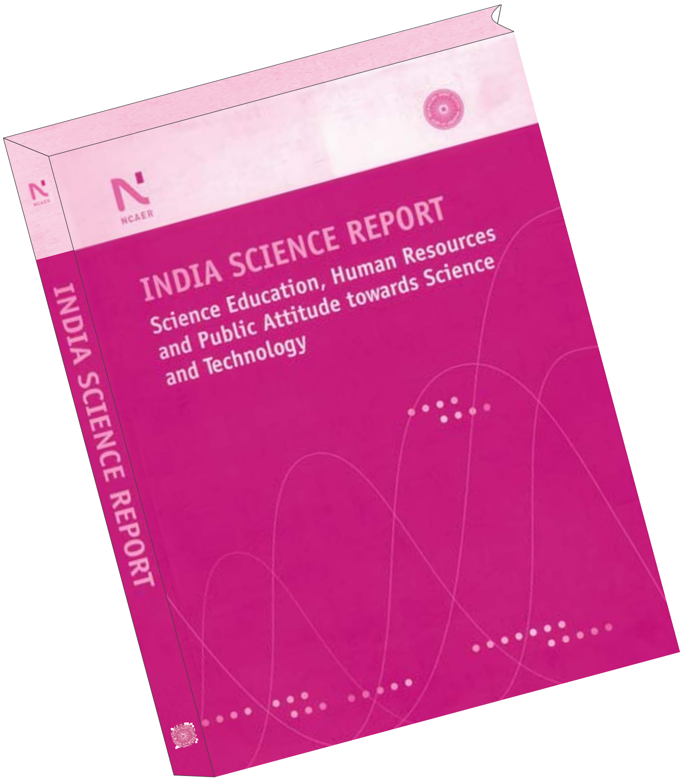
Publication : **India Science Report**

Principal Author : **Rajesh Shukla**

Publisher : **National Council of Applied Economic Research**
Parisila Bhawan, 11,
Indraprastha Estate,
New Delhi-110002

Year : **2005**

Pages : **144**



The level of progress achieved in science and technology (S&T) in a country is also indicative of its economic and social development. Many developed countries periodically employ statistical tools to measure the level of scientific and technological advancements in order to finalise various policies, plans and developmental strategies. In this context, a reliable database on Indian science and technology was a long felt requirement which appears now accomplished with the publication of India Science Report 2005 (ISR), first of its kind in India by National Council of Applied Economic Research (NCAER). The ISR is infact an outcome of a massive team work in the leadership of Dr. Rajesh Shukla, senior fellow, NCAER who is also the principal author of this outstanding publication.

ISR incorporates studies and valuable informations especially on science education in India, human resource in science and technology (S&T) and public understanding of science (PUS). As a prelude to bringing out ISR, a National Science Survey (2004) was funded and conducted by Indian National Science Academy (INSA) with the help of NCAER.

The report is organised under following broad chapters - education, human resource in S&T and public understanding of science. It is profusely illustrated with very useful list of tables, boxes and figures in support of its claims and conclusions. The report presents a comprehensive account on how our present day scientific and human resource is being utilised (or underutilised!) and how scientists and teachers of this country are being prepared to face the challenges of the future. ISR has frequently used hither to available international relevant data, classifications and definitions to drive home the point and to ensure the comparability of results with contemporary findings at international level.

Some of the ISR's inferences are worth mentioning here. According to the report amongst graduates who are unemployed, 22.3% have studied science. The share of unemployed science post graduates amongst the total unemployed postgraduates is still higher, i.e., 62.8%. In case of professional, technical and related job employment, 29% of the total employed are educated in science streams. But again a fourth of all unemployed in India are those with science education

ISR has also measured the Indian students' attitude towards science education. It may appear surprising to many but according to the report, mathematics remains the most preferred subject among Indian students. Almost third of all students in classes 6 to 8 rate it as a number one subject and the trend continues more or less upto even graduate and post graduate levels, where 21% students opt for mathematics as their number one choice.

There has been much hue and cry over declining interest of Indian students in science in these days but here too ISR's findings are quite different. It clearly states that there is no decline in interest in the proportion of students wishing to study science as 60% of the students of classes 6 to 8 showed interest in persuing science education.

The same trend continued even upto classes 11 and 12. However, at the classes 6 to 8, while 22% of the students showed their willingness to study pure science at higher levels of education, only 13.4% at classes 11 to 12 wanted to study pure science at the graduate and post graduate levels.

The report further finds that amongst 52.6 million graduates, postgraduates and diploma holders in India, a fourth of them are with science background. Report also states that around 11% of the work force can be classified as 'scientific' by way of education and 7.3% by way of its occupation. Obviously, this is an area which needs urgent attention.

Contrary to popular perception, the report's findings indicate that Indians have great faith in science. More than three forth of the interviewed people felt S&T is important for education while 58% emphasised its importance for economy, 72% felt its necessity for agriculture. More than three fourth were of the opinion that S&T makes lives healthier and more comfortable. ISR's findings on the level of scientific knowledge of common Indian people may seem surprising to many as report claims that 57% to in some cases even 80% people gave correct answers to the questions based on general and everyday science. Report also highlights that traditional knowledge is still alive in India. For example, 60% of the illiterates were of the opinion that one should not sleep under a dense tree at night and 75% considered plants as living organisms.

What are the sources of scientific information in India? According to report, it's skewed in favour of television. Just 12% Indians accept newspapers as their primary source of information while 65% of science news in India is acquired from television. Internet is still lagging far behind as a source of information to Indian people as only 0.2% of S&T information is acquired from internet in India as compared to 44% in United States. Now this is high time that government agencies concerned with science communication programmes in India should prioritise their communication strategies in accordance with the latest ISR findings. Report also strongly indicates the need for more expansion of internet and other digital infrastructures for S&T communication in India.

In a developing country like India, the desired socio-economic progress can only be achieved provided an appropriate S&T knowledge resource base exists and its dissemination and impact are regularly monitored. Also, the development of S&T plans and programmes based on science policy requires a regular flow of up-to-date, reliable and comprehensive data. In this direction, ISR is the first independent collection of relevant statistics on various aspects of Indian S&T. But as the authors of this monumental work modestly submit that first ISR's role is that of "only a whistle-blower", lot still remains to be done. ISR 2005 is not an ultimate event or a final document but only a humble beginning of an essential process in a country which is on the threshold of becoming a knowledge society.

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News

Science Writers' Workshop with a Difference

For those who are concerned about the introduction of genetically modified food and other products being permitted into market network, the answer lies in international biosafety framework, which has been formalisd in the Cartegena Protocol on Biosafety. Protocol had given a big nod for the biosafety regime and the intense efforts are on around the world to strengthen the regime and educate the masses on the issue to that no wrong notions are allowed to take off with such sensitive and future defining issue. Science Writers' Workshops on Biosafety were organised last year in New Delhi and Chennai with exactly these motives by the Ministry of Environment and Forests, Govt. of India in association with the Indian Science Winters' Association (ISWA) and Science Technology and Development Initiative (STAD). The first workshop was organised on July 5-6, 2006 in New Delhi and second in Chennai on December 22-23, 2006.

The Cartegena Protocol promotes biosafety by establishing practical rules and procedures for safe transfer, handling and use of GMOs with a specific focus on regulating movements of these organisms from one country to another country. The Workshop on Biosafety for Science Communicators was planned as a serious exercise not only on the preceding sciences of biosaftey but also to give a serious thought on science media society interdependence. Both these workshops had a plenary session each in which a panel discussion involving eminent professionals worked on the strategies relating to the subject of the workshops. In New Delhi, Prof. V. L. Chopra, Member, Planning Commission was the Chief Guest to inaugurate the workshop.

The plenary session provided a wholesome look on the issue along with the concerns on enhancing scientific awareness of the society. These sessions came out with recommendations needed for greater appreciation of science in general and biosafety and biotechnology in particular.

"Inaugural Session of The Science Journalists' / Writers' Workshop on Biosafety in Progress at The Indian National Science Academy (INSA), New Delhi"

The sessions deliberated towards the Strategies for Media Science Communion to Society's Advantage. The proceedings laid emphasis on greater media scientist and also sensitisations of each professional category o others requirements and sensibilities. Media editors should be sensitised to providing adequate space to science.

Another set of recommendations dwelt upon orientation programmes to media men. Scientific institutions should organic regular media interactions on the issues of contemporary interests. Media fellowships are considered a good strategy for generating media content as well as inviting journalists' interest into science and technology.

S&T organisations should give weight-age to their scientists for efforts towards science popularisation. It is not in good spirits towards society to impose restrictions on media interaction of scientists by research institutions.

Web initiatives needs to devise new strategies for greater involvement of scientists and journalists and also interaction amongst these. The session also recommended for establishing a biosafety network of journalists and scientists.

Adequate emphasis is also needed for popularising science through vernaculars. People speaking vernaculars are the one who need to be reached by breaking language barrier. A science television channel in vernaculars is certainly an idea that hugely needs to be attempted at, with science and technology dissemination as knowledge profit having precedence over financial profit.

Scientific advances and its application towards the advantage of the society at large has not remained a simple issue any more. There are pros and cons aplenty and vested groups have their own stories to narrate. If common man has to be judicious enough to put a tab on ill informed decisions and ill designed motives then media is to be engaged and involved to the fullest.

The workshop at Chennai was inaugurated by Prof. S. Kannaiyan, Chairman, National Biodiversity Authority, Chennai.

AAAS Science Journalism Awards

The American Association for the Advancement of Science (AAAS), the world's largest general scientific society, is now accepting entries for the 2007 AAAS Science Journalism Awards.

The deadline for submissions is August 1, 2007. The contest year is July 1, 2006 to June 30, 2007.

Each category winner will receive $3,000, to be presented at the AAAS Annual Meeting in February 2008 in Boston. AAAS will cover each winner's annual meeting related travel and lodging expenses.

International Category entries shall be eligible in the category of Children's Science News and is Open to journalists worldwide for work distributed via any medium.

The AAAS Science Journalism Awards recognise outstanding reporting for a general audience and honor individuals (rather than institutions, publishers or employers) for their coverage of the sciences, engineering and mathematics.

Since their inception in 1945, the awards have honored more than 300 individuals for their achievements in science journalism. Independent screening and judging committees select the winning entries based on scientific accuracy, initiative, originality, clarity of interpretation and value in fostering a better understanding of science by the public.

For more information please visit:
http://www.aaas.org/aboutaaas/awards/sja/index.shtml

Academy of Science Communicators planned

PCST, an International network devoted to science communication has announced it will set up an academy to promote activities in the field.

Vladimir de Semir, chair of PCST (the International Network on Public Communication of Science and Technology), made the announcement at the network's ninth International conference in Seoul, South Korea.

De Semir, who is also commissioner for scientific culture at Barcelona City Council, Spain, said the academy would enable the network to organise regular research and other activities relating to science communication.

So far, PCST has been a loosely organised body whose role has been limited to editing journals about science communication, publishing a small number of books and holding a biannual international conference.

"Currently, all of our members work as part time volunteers, but this has not met the increasing global demand for better research and practices in the field of science communication," de Semir told SciDev.Net.

De Semir said the academy would be formally set up in July, but he would not reveal its planned location or number of staff.

The academy will raise funds to support the network's activities in the developing world. It will also operate a regularly updated website that will gather information on science communication.

Bruce Lewenstein, a professor of science communication at Cornell University in the United States and a member of the PCST executive committee, says the academy will help the network to better coordinate its resources and activities.

(Source : SciDev.Net)

(Contd. from page 33)

UN Declaration on Science and the Use of Scientific Knowledge

create a critical mass of national research in the sciences through regional and international cooperation is especially important for small States and least developed countries. Scientific structures, such as universities, are essential for personnel to be trained in their own country with a view to a subsequent career in that country. Through these and other efforts conditions conducive to reducing or reversing the brain drain should be created. However, no measures adopted should restrict the free circulation of scientists.

36. Progress in science requires various types of cooperation at and between the intergovernmental, governmental and non-governmental levels, such as : multilateral projects; research networks, including South-South networking; partnerships involving scientific communities of developed and developing countries to meet the needs of all countries and facilitate their progress; fellowships and grants and promotion of joint research; programmes to facilitate the exchange of knowledge; the development of internationally recognised scientific research centres, particularly in developing countries; international agreements for the joint promotion, evaluation and funding of mega projects and broad access to them; international panels for the scientific assessment of complex issues; and international arrangements for the promotion of postgraduate training. New initiatives are required for interdisciplinary collaboration. The international character of fundamental research should be strengthened by significantly increasing support for long term research projects and for international collaborative projects, especially those of global interest. In this respect particular attention should be given to the need for continuity of support for research. Access to these facilities for scientists from developing countries should be actively supported and open to all on the basis of scientific merit. The use of information and communication technology, particularly through networking, should be expanded as a means of promoting the free flow of knowledge. At the same time, care must be taken to ensure that the use of these technologies does not lead to a denial or restriction of the richness of the various cultures and means of expression.

37. For all countries to respond to the objectives set out in this Declaration, in parallel with international approaches, in the first place national strategies and institutional arrangements and financing systems need to be set up or revised to enhance the role of sciences in sustainable development within the new context. In particular they should include : a long term national policy on science to be developed together with the major public and private actors; support to science education and scientific research; the development of cooperation between R&D institutions, universities and industry as part of national innovation systems; the creation and maintenance of national institutions for risk assessment and management, vulnerability reduction, safety and health; and incentives for investment, research and innovation. Parliaments and governments should be invited to provide a legal, institutional and economic basis for enhancing scientific and technological capacity in the public and private sectors and facilitate their interaction. Science decision-making and priority setting should be made an integral part of overall development planning and the formulation of sustainable development strategies. In this context, the recent initiative by the major G-8 creditor countries to embark on the process of reducing the debt of certain developing countries will be conducive to a joint effort by the developing and developed countries towards establishing appropriate mechanisms for the funding of science in order to strengthen national and regional scientific and technological research systems.

38. Intellectual property rights need to be appropriately protected on a global basis, and access to data and information is essential for undertaking scientific work and for translating the results of scientific research into tangible benefits for society. Measures should be taken to enhance those relationships between the protection of intellectual property rights and the dissemination of scientific knowledge that are mutually supportive. There is a need to consider the scope, extent and application of intellectual property rights in relation to the equitable production, distribution and use of knowledge. There is also a need to further develop appropriate national legal frameworks to accommodate the specific requirements of developing countries and traditional knowledge and its sources and products, to ensure their recognition and adequate protection on the basis of the informed consent of the customary or traditional owners of this knowledge.

4. Science in society and science for society

39. The practice of scientific research and the use of knowledge from that research should always aim at the welfare of humankind, including the reduction of poverty, be respectful of the dignity and rights of human beings, and of the global environment, and take fully into account our responsibility towards present and future generations. There should be a new commitment to these important principles by all parties concerned.

40. A free flow of information on all possible uses and consequences of new discoveries and newly developed technologies should be secured, so that ethical issues can be debated in an appropriate way. Each country should establish suitable measures to address the ethics of the practice of science and of the use of scientific knowledge and its applications. These should include due process procedures for dealing with dissent and dissenters in a fair and responsive manner. The World Commission on the Ethics of Scientific Knowledge and Technology of UNESCO could provide a means of interaction in this respect.

41. All scientists should commit themselves to high ethical standards, and a code of ethics based on relevant norms enshrined in international human rights instruments should be established for scientific professions. The social responsibility of scientists requires that they maintain high standards of scientific integrity and quality control, share their knowledge, communicate with the public and educate the younger generation. Political authorities should respect such action by scientists. Science curricula should include science ethics, as well as training in the history and philosophy of science and its cultural impact.

42. Equal access to science is not only a social and ethical requirement for human development, but also essential for realising the full potential of scientific communities worldwide and for orienting scientific progress towards meeting the needs of humankind. The difficulties encountered by women, constituting over half of the world's population, in entering, pursuing and advancing in a career in the sciences and in participating in decision-making in science and technology should be addressed urgently. There is an equally urgent need to address the difficulties faced by disadvantaged groups which preclude their full and effective participation.

43. Governments and scientists of the world should address the complex problems of poor health and increasing inequalities in health between different countries and between different communities within the same country with the objective of achieving an enhanced, equitable standard of health and improved provision of quality health care for all. This should be undertaken through education, by using scientific and technological advances, by developing robust long term partnerships between all stakeholders and by harnessing programmes to the task.

44. We, participants in the *World Conference on Science for the Twenty-first Century* : *A New Commitment*, commit ourselves to making every effort to promote dialogue between the scientific community and society, to remove all discrimination with respect to education for and the benefits of science, to act ethically and cooperatively within our own spheres of responsibility, to strengthen scientific culture and its peaceful application throughout the world, and to promote the use of scientific knowledge for the well being of populations and for sustainable peace and development, taking into account the social and ethical principles illustrated above.

45. We consider that the Conference document *Science Agenda - Framework for Action* gives practical expression to a new commitment to science, and can serve as a strategic guide for partnership within the United Nations system and between all stakeholders in the scientific endeavour in the years to come.

46. We therefore adopt this *Declaration on Science and the Use of Scientific Knowledge* and agree upon the *Science Agenda - Framework for Action* as a means of achieving the goals set forth in the Declaration, and call upon UNESCO and ICSU to submit both documents to the General Conference of UNESCO and to the General Assembly of ICSU. The United Nations General Assembly will also be seized of these documents. The purpose is to enable both UNESCO and ICSU to identify and implement follow-up action in their respective programmes, and to mobilise the support of all partners, particularly those in the United Nations system, in order to reinforce international coordination and cooperation in science. ■

Letters to the Editor

महोदय,

इंडियन जर्नल ऑफ साइंस कम्यूनिकेशन का 'जनवरी–जुलाई 2005 का अंक कई वैज्ञानिक लेखों को समायोजित करता हिन्दी एवं अंग्रेजी दोनों में प्रशंसनीय व सराहनीय है। डॉ. शुकदेव प्रसाद ने अपने लेख 'विज्ञान कथा' से हिन्दी में विज्ञान की संप्रेषण कर देश में ही नहीं विदेशों में हिन्दी विज्ञान लेखन का संकलन कर डॉक्टर, इंजीनियर, वैज्ञानिकों, आदि में क्रांति की लहर दौड़ा दी है। धन्यवाद। वस्तुत: वर्ष में दो बार निकलने पर यदि हिन्दी को सम्मान दिया जाता है और उसे वैज्ञानिक अंदाज में पेश किया जाता है तब पाठकों में हिन्दी के प्रति जागरूकता पैदा होती है। विज्ञान विषय पर यदि हिन्दी भाषा में, हो रहे आविष्कारों का विवरण आपके पत्रिका के माध्यम से आ सके, तो पत्रिका में पाठकों की रुचि हिन्दी के प्रति काफी बढ़ेगी। यह हिन्दी वैज्ञानिकों, लेखकों एवं पाठकों के बीच सेतु का कार्य करेगी।

हिन्दी संस्कृति के विकास एवं स्वदेशी तकनीकों के विकास में सार्थक है। जब सांस्कृतिक एवं सामाजिक मापदण्डों पर बेहतर जीवन देने में विज्ञान सक्षम है तो उसे क्यों न अपनाया जाए जिसके लिए हिन्दी माध्यम ही सर्वश्रेष्ठ है जो हमें एक सूत्र में पिरो देती है। हिन्दी को राजभाषा का दर्जा तो दिया गया है लेकिन इस पर अमल कितने व्यक्ति करते हैं यह एक प्रश्न चिह्न है। फिर विज्ञान मूकदर्शक बन जाता है। हमारे देश के वैज्ञानिकों को समुदाय में एक ऐसा आविष्कार करना चाहिए कि जन–जन में हिन्दी के प्रति रुचि बढ़े और विज्ञान एवं प्रौद्योगिकी के व्यवहारिक कार्य को समझकर अपने जीवन में हो रहे अनायास कष्टों में छुटकारा पा सकें। सम्पूर्ण राष्ट्र में हिन्दी में प्रौद्योगिकी नीति को न सिर्फ अपनाया जाए बल्कि अमल भी किया जाए। इसके अंतर्गत राष्ट्रीय प्राथमिकताओं एवं संसाधनों के अनुकूल स्वदेशी तकनीकों का विकास, स्ट्रेटैजिक एवं क्रांतिक क्षेत्रों में राष्ट्र में उपलब्ध अधिकाधिक संसाधनों द्वारा तकनीकी सक्षमता एवं स्वावलम्बन प्राप्त किया जाना चाहिए। हम किसी दूसरे देश के दबाव में कोई ऐसा कार्य या निर्णय न लें जिससे देश के सम्मान में ठेस पहुंचे। देश सर्वोपरि है।

यह अंतर्राष्ट्रीय पत्रिका विज्ञान संचार के क्षेत्र में जीवन्त बनी रहे, यही ईश्वर से कामना है।

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