What else can we do to enhance the scientific potential of India?

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Considerable and sincere efforts are being made to enhance the reach and tempo of science education and research in India. An unprecedented increase in budgets, new institutes and learning centers, involvement of NRI scientists and the Department of Science and Technology inspired programmes like INSPIRE can now be seen. These efforts are steps in the right direction.

There is however, a gap that still needs to be addressed: that of a disconnect between the teaching community at universities or colleges and those engaged in active research. Many teachers of S&T have no access to modern research or even modern scientific literature to update themselves with. This is an important gap that needs to be bridged, if we have to attract young talent to the sciences. In Europe and US, research scientists interact directly with undergraduate and even high school students; this is something that does not happen in India. Here active researchers generally do not get to teach. Conversely, the college and university teachers with no access to the current scientific literature, only teach what they learned years ago. We therefore need to develop a mechanism to bridge this gap and provide access to current scientific research literature to a college teacher on a continuing basis. The direct result of this interaction will be that at a much younger age, students of science would get a first-hand description of the infectious excitement of research vicariously from their teacher. In the system as it stands now, this disconnect between science in classes and science in laboratories leaves students clueless, and therefore makes them ambivalent about a career in science.

What can we do to rectify within the boundaries of our existing system? There are few changes which can be implemented without a major overhaul. And, these may have a direct impact in taking scientific rigour to the masses. This is based on the fact that, the largest impact to the target community comes from their science teachers. If one can reach out to the teachers, they will naturally help in reaching the students of today and the scientists of tomorrow. Each teacher has a minimum amplification factor of 100, and this component of education and research cannot, and should not, be ignored. Some ways in which this can be done are outlined below.

(1) Science education can be lackluster not because teachers are sub-par, but because they are unable to update themselves to the latest developments in science that they teach. One way to rectify this is to use the ubiquitous reach of internet by giving teachers in colleges/universities access to scientific journals and reviews online. A simple provision of a computer and an internet connection with access to scientific libraries like the Science Direct or the PROLA, via systems such as INFLIBNET will suffice. Such an initiative would cost approx. Rs 100 crores to reach nearly 50,000 teachers, translating indirectly to 5,000,000 students. Further, to ensure its use, one could make it contingent that upgradation of computers and periodic renewal of their internet access will be tied to their publishing in a peer-reviewed journal. This might lead to a healthy competition and provide for a win–win situation for all.

Presently most IITs, IISERs and central universities provide up to a Rs 1 lakh, or thereabouts to every teacher for professional upgradation, travel and contingency expenses. The proposed scheme will be on the similar lines and can be taken as an effort to help teachers upgrade themselves in their profession.

(2) It could be made mandatory for National Research Institutions and well-funded centres such as IITs, IISERs and Central Universities to host college/university teachers as active collaborators on a long-term basis. Each institution should be able to host up to 20% of the number of its total scientific strength (i.e. faculty strength) every year. In collaboration with the host institutions, a national programme could facilitate travel and honorarium to cover local costs. India currently has approx. 200 S&T research centres. If each one hosts about 20 teachers/year, this translates to about 4000 college teachers who get to participate in active science. And, they can then share the excitement of scientific process and rigour to their ~4,00,000 or more students! A conservative 1% success in enthusing students will provide for 4000 students willing to plan a career in science. And this can happen for a meagre cost of approx. Rs 10 crores per year. The value added benefit of this exercise would be of providing facilities to college and university teachers for active research to further their own science dreams and, at the same time providing skilled manpower to research centres leading to optimum utilization of resources. Most institutions now have the facilities and infrastructure but lack skilled scientists to run on a 24×7 basis. Such a synergy will auger well for Indian science landscape and will go a long way in reaching out the students at the college and village levels.

(3) It may not be unwise to take a leaf from US and Europe in working towards this goal. They attract the brightest minds of the world to their country. Why can India not do so? Why can India be not a science destination for a major part of the world, particularly the developing world? It may be worth considering initiating Indian Science Fellowship Programmes (ISF) on the lines of Humboldt Foundation Fellowship of Germany, the Leverhulme Foundation of UK and the NSF Fellowships of the USA. Let us make India a science destination and target bringing in several hundred bright young scientists from Africa, South America and the developing world. An internationally competitive ISF programme could be generated that provides a decent fellowship and working environment to the ISF holders, at premier institutions of India. A budget outlay of Rs 50–100 crores will provide for 1000 bright minds coming to the country and enriching our science. This estimate is based on a fellowship of say Rs 50,000 per month and a travel support (also for spouse). These scientists with time-bound research objectives will not only enrich our science but inculcate efficiency and healthy competition into Indian research. As an incentive, faculty hosting these scientists may be appropriately graded and rewarded with a monthly remuneration.

It is important to realize that these scientists in the long run will be the ambassadors of India and its science/culture. There are some mechanisms in India for

personnel exchanges in science. However, these are limited in their scope. China has already taken giant leaps in this area and we need to think strategically over the long-term impact such an effort will have.

From the experience of hosting multiple scientists from many countries, one of us has found that the tedium and the stress of organizing visas and residence permits are a significant deterrent to both the host and the host institution. Simplifying this process at the Home Ministry and other levels could reap benefits for India in developing a talent pool as well as goodwill. These scientists will enrich our science, will be our ambassadors in the world and will create goodwill for the nation. It may also encourage NRI scientists to return, if they know that they can recruit postdocs and scientists from other countries, in India to work in their labs and enhance productivity. There is a clear role for the Indian Science Academies here.

(4) Many Indian scientists publish in Indian journals. While one feels proud of these indigenous journals, there is a glut of these which dilutes the visible quality of Indian science and the international respectability of these journals. We could consolidate the scientific publishing landscape and generate fewer, higher impact journals which attract not only Indian science, but also the science from overseas. This would help publicize our existence and efforts. Some of the Indian geosciences journals are now attracting international contributions.

(5) Science is becoming increasingly networked. Our students and educators can only benefit from remaining plugged into the fast-paced changes and developments. With the experience of one of us in organizing multiple international conferences at Physical Research Laboratory and on behalf of UNESCO, we believe that bringing international spotlight to India has to be of prime importance to bring both enthusiasm and collaboration to our colleagues. An easy way of doing so is to bring major international congresses/symposia to India and use these as a forum for science education via the EDUNET and similar mechanisms. A case in point for this is China which has hosted all the major congresses in almost all the fields in S&T in the last two decades. This has helped China to leapfrog its science base from almost zero to the high levels it is reaching today. Appropriate funding and involvement of the Ministries of External Affairs and Home Affairs are necessary to facilitate such events. Clearances from finance departments for the bid process for conducting these meetings should not be delayed. We need some proactive attitude in this and the academies can play a constructive role of interfacing the bureaucracy with the academics.

It may also be useful to create platforms for major Indian meetings combining various disciplines such as the American Geophysical Union that is attended by several thousands. A few years ago, some of the geoscientists including one of us, mooted the idea of hosting a National Geosciences Meeting attracting all the Geosciences disciplines. It was expected to provide a platform for interdisciplinary exposures within geosciences and to develop major national initiatives. Even though it was well received by the Indian geosciences community, it has not happened so far due to inadequate funding mechanisms for such large meetings.

Perhaps if we fan our efforts to reach all strata of this society, down to the students and their teachers in villages and small colleges, this momentum may gain traction, and the dream and vision of a scientific India will be closer to reality.

We reiterate that we need to change our mindset and work with a passion to take our science to a higher level. We need to do this at all levels so that the conditions of our academic catchments improve. And, we need to act now as five years hence it might be too late to catchup with our counterparts. We are already far behind.

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Losing one million hectare net sown area in India

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The issue of declining net sown area (NSA) has been highlighted as a major concern for Indian agriculture in recent years[1]. According to the Food and Agricultural Organization (FAO) of the United Nations, about 59.2 million ha of land had degraded in India by 2003 – the 1991 assessment placed the figure at 45.0 million ha (ref. 2). This is over and above the extent of land that has already degraded. In this context, data such as the one showing a decline of one million ha in NSA during 2003–04 (ref. 3) is unprecedented (Figure 1) that seems to lend credence to the FAO's assessment. The decline cannot be fully explained by fluctuating rainfall as even severe droughts during 1980s have not resulted in such a decline. Clearly, soil health deterioration leading to land degradation, and land acquisition for urbanization, infrastructural activities and special economic zones (SEZ), as indicated through steady rise in area under non-agricultural uses (Figure 1) have had their impact.

Trends in land use in India indicate that NSA has stabilized at about 140 million ha from 1980s onwards[3]. The decline in NSA during 2002–03 may be attributed to lower average rainfall resulting in increased current fallows. Similar reduction in NSA was also recorded during 1988–89, which was also a below normal