literature is available on controlling a few of these species as well[7,8]. The fact that they still position in the top 100, reflects the urgency to bring their populations under control. The species listed above are easily identifiable and substantial literature exists on various aspects of their biology.

Given this information, we suggest regulated use of these invasive organisms for animal dissections in different zoological research and study curricula. Such a substitution adheres to almost all of the University Grant Commission (UGC) recommendations (under Section B – Objective/Aim to be achieved). Dissection of invasive animals partly adheres to recommendation B.1.1, as none of the suggested animals comes under the Wildlife Protection Act currently enforced in India. This substitution does not affect B.1.2, since dissections of these animals would also be regulated. B.1.3 could be modified by substituting 'invasive species' in place of the native animal species. Due to this, the onus of mass captive rearing, especially in smaller colleges with limited facilities, will be lessened to an extent. B.1.4 could be modified on the lines of B.1.3. For recommendation B.1.5, a species selected for dissections in postgraduate curriculum could in itself be an invasive species. The syllabus could be amended accordingly, as there is a lot of literature on all biological aspects of these animals. Using the invasive species for dissection would not directly affect any long-term recommendations given by the UGC.

Public dissemination of such knowledge will definitely help governmental bodies to modify the regulations as is already being considered by the Ministry of Environment and Forests[9,10]. Use of such species will not only aid the students and researchers, but also help in controlling the damage caused by them on the native flora and fauna.

We completely agree that rampant use of animals caught in the wild for vivisection, especially the scheduled species[11], should be avoided at all costs. Substitution of exotic species for regulated dissections in the present curriculum can be a good strategy for both alleviating the pest problem and not compromising on quality of life sciences education.

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S&T R&D in Indian academia

The recent well-thought-out comments by Narayana Murthy[1] in his convocation address at the Indian Institute of Science (IISc), Bengaluru have elicited equally interesting comments by scientists, including Rao[2] and Mashelkar[3] among others.

I would like to focus on two kinds of R&D carried out in our academia.

The first is basic research which is curiosity-driven and is of a long range. The results can be major contribution to global knowledge and can receive worldwide recognition. The work of S. N. Bose, G. N. Ramachandran, etc. falls in this category, as noted by Mashelkar[3]. For India to make greater progress and impact in this direction calls for:

(1) Careful identification of the rare individuals who possess the intelligence and deep commitment for such research. These are likely to be found in a few of our leading academic institutions (IISc, IITs, IISERs) which have the proper ambience. They may constitute 5%–10% of the faculty in these institutions.

(2) Having identified such geniuses, support them handsomely with 5-year renewable grants instead of the usual short-term grants. The support comes basically from public (Government) funds. Rigorous selection of the awardees is essential because our Government funds for research are very limited by world standards.

(3) Once identified and funded, they should be left alone to pursue their chosen endeavours, as pointed out by J. B. Conant, President of Harvard.

(4) Administrative and bureaucratic obstacles should not come in their way.

(5) The progress of their work and publications are to be reviewed by a competent committee (with international participation) leading to support at an enhanced, or similar or lower (including none) for the next 5-year term.

(6) These steps, if implemented fully, will produce some Boses and Ramchandrans and maybe Ramans and Ramanujans.

The second area, which is of equal importance, is R&D to solve problems facing Indian society and industry. In this case, the first crucial step is to identify such problems by faculty members or the beneficiaries in industry or society, preferably jointly. Then a proposal is to be prepared, again with inputs from both sides to an appropriate extent, stating the

goals, methods, approach, costs, timeline, expected results, modes of implementation, etc. The project will conclude only when it is implemented fully and satisfactorily in the premises of the beneficiary. Half of the estimated cost is to be provided by the industrial partner and the other half from the Government. Some of the Government share may go towards equipment, since the industry is normally reluctant to contribute to permanent equipment. The industry is given 100% tax exemption for the funds provided to the academia. This route puts onus on the faculty to identify a problem of great importance to the industry end-user who is willing to pay, and onus on the industry to seek a faculty member equipped and willing to solve their problems of importance. This process will ensure closer interaction between academia and industry than existing now, which will result in mutual respect and a sense of partnership. When the originator or the beneficiary is a small-scale industry or a societal body, the Government may bear more than half of the project cost, including all of it. Even in this case, identification of the problem and the beneficiary is critical.

This approach will generate innovative, implementable solutions to our problems, whether industrial or societal. The industry will move away from its past tendency to import foreign technology or pursue reverse engineering, etc. The project will conclude only when it is fully implemented to the satisfaction of the beneficiary and has delivered the promised results or more. Papers and patents are only secondary outputs in this case.

Is this just a kite-flying exercise, or can it work in the Indian scenario? It is true that this is not an easy path, primarily because academia and industry are driven by different goals – for academia, it is publish or perish, and for industry, it is a quick, cost-effective, guaranteed solution. The government can help in bringing them together through a tax break and cost-sharing. Can it happen in the Indian context, or has it ever happened? The Institute of Chemical Technology, Mumbai, which is now a Deemed University, earns a sizable portion of its expenses from the industry[4]. Some of the CSIR laboratories (e.g. National Chemical Laboratory) earn a respectable sum from the industry. Another successful example is the public–private partnership, i.e. 'New Millennium Indian Technology Leadership' initiative, started by CSIR. Tata Research Development and Design Centre, Pune, set up in 1981 with a mission of 'using existing knowledge for the benefit of our industry and our people' (in the words of J. R. D. Tata), earns much of its expenses from the beneficiary industry by providing cost-effective, time-bound, implementable solutions with guaranteed benefits of improved productivity, lower energy consumption and improved quality with the existing equipment and personnel[5]. The research team and the beneficiary become partners, and not giver and recipient.

The present-day problems are complex and require multi-disciplinary teams of scientists, engineers and even designers to work together with shop-floor personnel. Such multi-disciplinary teams can best be assembled only in our leading academic institutions.

In summary, some geniuses in our leading educational institutions should be identified and supported handsomely for 5-year terms for blue sky, open-ended fundamental research. Secondly, a major effort should be made by bright faculty in IISc, IITs, etc. to tackle important societal and industrial problems in a time-bound manner, with the end goal of successful implementation in the premises of the beneficiary leading to clear benefits. This activity should be funded (half) by industry or the beneficiary who is given 100% tax rebate, and by the Government matching the industry support. This will bring about academia–industry partnership for national good and for enabling India to take its rightful place among the top economic powers.

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Knowledge dissemination in earth system science in India

This letter discusses the advances in knowledge dissemination techniques in the country in earth system science with techniques to improve the national advisories. A new scheme is suggested here for maximal utilization of the country's resources and for disaster management in the light of the new policies incorporated by the Central Government – the Digital India and National Knowledge Network (NKN) scheme.

The Earth System Science Organization (ESSO), New Delhi, operates as an executive arm of the Ministry of Earth Sciences (MoES), Government of India for its policies and programmes. The primary aim of ESSO is to develop and improve the capability to forecast weather, climate and hazard-related phenomena for social, economic and environmental benefits, which include climate services. The aim is to provide the nation with the best possible services in forecasting monsoon and other weather/climate parameters, including early warnings of natural disasters like storm surge, earth-quakes, tsunamis and other phenomena through well-integrated programmes. Knowledge dissemination methods of ESSO-MOES should mainly target three goals and fall into three tiers based on a descending order of importance:

(1) Tier 1 – Saving lives: This is the primary responsibility of any government and it has been done in a systematic manner by various public and private groups. This includes evacuation of the people and resettlement, as has been done all round the world from ancient times.