Trans-disciplinary research in India – a scenario for the developing world

As far back as in early 1970s, the Department of Science and Technology, Government of India, and the Ministry of Human Resource Development (then known as Ministry of Education), gave firm thrusts towards development of a strong culture for trans-disciplinary R&D in India. Their concern had been fuelled by the recognition that the conventional unidisciplinary approach was beginning to throttle creativity. Thus, the concept of 'mission-oriented education and research' was aggressively introduced into the Indian system. The distinguishing features of this concept are: (i) it beckons the researchers to work on real-life problems of high and immediate relevance; (ii) it nudges the universities to start 'interdisciplinary' and 'trans-disciplinary' programmes leading to Master's degrees/ diplomas; (iii) it leads to the setting up of departments/centres/units in the universities (especially Central universities and IITs), colleges and national laboratories with names that suggest the breadth of fields such as 'Centre of Studies in Resources Engineering', 'Centre for Theoretical Studies' and 'Centre for Advancement in Rural Technology'.

Despite the bold policy initiatives mentioned above, there is little trans-disciplinarity in Indian research, in the true sense of the term. The two illustrative examples from our direct experiences bear this out: (i) At Centre for Water Resources Development and Management at Kozhikode, India, one of the authors (S.A.A.) was associated with a trans-disciplinary project involving four R&D divisions of the Centre. In this case and in another trans-disciplinary project, the projects were conducted by allotting different fragments to different divisions, and then operating them as if they were independent projects with little interaction between the participating divisions; (ii) Even though Pondicherry University is one of the youngest universities (established in 1986), there is hardly any major research project taken up, and none completed, in which more than one of its schools/departments/centres jointly participate.

The reasons, which also provide clue to the possible solutions, are: (i) lack of sufficient weightage in career advancement – In schemes for career advancement and grant proposals, trans-disciplinary work is formally noted to be important but little weightage is attached to it and one loses nothing if one has not tried to interact with others; for instance, in the performance-based assessment system (PBAS) recently introduced by the University Grants Commission[1]. In fact, PBAS has put in a strange stipulation according to which the 'first author' of any paper or book gets 60% of the total points and the remaining authors share the balance 40%. This kind of stipulation further discourages inter-faculty collaboration because the authors other than the 'first' author get very little of the weightage. (ii) Bureaucratic hurdles – India, and most other developing countries, have lot more of red tape than the developed countries. (iii) Absence of the mechanism and the will to encourage excellence – numerous factors, both political and social, have contributed to building up a system which almost flinches while trying to encourage excellence. Excellence is sought and encouragement is promised – but only in words[2]. In practice, career advancement almost always goes by the number of years spent by a researcher.

Islands of trans-disciplinary activity do exist in India. Such 'pockets of trans-disciplinarity' are formed in the following manner: (i) two researchers working in different departments or different institutions happen to develop good interpersonal equations and interact professionally. (ii) Teams of research scholars and postdoctoral scientists trained in different conventional disciplines work under a single supervisor. These success stories prove that there are no socio-cultural barriers that hinder trans-disciplinary research in India. (iii) In the R&D laboratories of national institutions, scientists trained in different disciplines are made to work in a single unit or division. But, barring a few exceptions, this type of 'forced integration' does not foster trans-disciplinarity in the real sense of the term.

1. UGC regulations on minimum qualifications for appointment of teachers and other academic staff, 2010; http://www.ugc.ac.in/notices/notice.html (last accessed February 2012).
2. Abbasi, T. and Abbasi, S. A., *Science*, 2012, **336**, 296.

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Shale gas – a future energy alternative

The world is presently facing two energy problems in the medium to long term approach – climate change and peak oil. Compared to new discoveries, news about depleting oil fields is more in focus now. Major oil companies are going further into the ocean to dig deeper in their pursuit for fossil fuels and difficult deep-water locations seem to be the norm for the exploration companies, increasing the costs of the operations and hence the costs of fossil fuel itself.

Natural gas is a cleaner burning alternative than coal or oil. The combustion of natural gas emits significantly lower levels of key pollutants, including carbon dioxide, nitrogen oxides and sulphur dioxide, than does the combustion of coal or oil. The most important factor is the gas price. If shale gas would cost less than the imported liquefied natural gas, the number of buyers will be more. Large shale gas deposits are found in the north-eastern states, Gujarat and Rajasthan.

Table 1. Projected gas demand in India (Million Metric Standard Cubic Meter Per Day)

	2010–11	2011–12	2012–13	2013–14	2014–15
Power	87.71	149.11	185.52	212.73	243.34
Fertilizer	49.39	57.48	68.08	68.08	68.08
City gas	13.70	17.53	22.44	28.72	36.76
Petrochem refinery	24.44	25.42	26.43	27.49	28.59
Sponge iron	3.71	3.82	3.93	4.05	4.17
Total	178.94	253.96	306.41	341.08	380.95

Shale gas may cost anything between US$ 3 and 7 per million British thermal units (mBtU).

The prevailing natural gas cost is about US$ 4.2–7 per mBtU. In India, the focus is on the development of indigenous shale resources. Indian shale deposits appear to be abundant and are found in the Bengal basin, Cauvery basin and Assam–Arakan basin. Geologists estimate that India's shale gas reserves are potentially larger than its proven conventional resources. As demand for cleaner energy sources rises, demand for natural gas in India could rise to 120 billion cm^3 a year by 2015 from 62 billion currently.

Based on the predictions made in Table 1, India's interest in the exploration and development of its abundant shale resources is a timely step in the right direction. A Memorandum of Understanding (MoU) on shale gas resources between India and USA was signed on 9 November 2010 during the visit of the US President to New Delhi. The main objectives of the MoU for cooperation in the field of shale gas include shale gas resource assessment in India, technical studies to commence on shale gas exploration in India and training of Indian personnel in the area of shale gas.

The upstream regulator of India, Directorate General of Hydrocarbons (DGH) has been asked by the Union Government to draft an approach paper for shale gas exploitation in India. The Union Government is presently evolving a policy framework for shale gas and the first shale gas round is planned for end-2013. The DGH has assured to bring out a policy on shale gas by mid-2013 (as assured in the Indo-US Bilateral Conference on shale gas at New Delhi, 19–20 March 2012). It should facilitate seismic surveys that can quickly delineate potential shale gas deposits, and then invite bids for exploration. Shale gas exploration blocks need to be delineated and a bidder-friendly policy may be evolved to facilitate the shale gas bidders to carry out exploration-cum-fast track exploitation activities in India. The government needs to come out with a shale gas policy as early as possible.

1. Blauch, M. and Greiser, B., *Special Techniques to Tap Shale Gas*, Hart Energy Publishing, Haliibruton, Houston, March 2007.
2. Simon, M., India steps on shale gas, *Offshore World*, June–July 2010, 35–36.

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Narcissus tazetta – a case study of biopiracy

Biopiracy is a compound word consisting of 'bio' which is a short form for 'biology' and 'piracy'[1]. Biopirates are those individuals and industries/companies accused of one or both of the following acts: (i) the theft, misappropriation of, or unfair free-riding on, genetic resources and/or traditional knowledge, and (ii) the unauthorized and uncompensated collection for commercial ends of biological/ genetic resources and/or traditional knowledge. Broadly biopiracy refers to the monopolization of genetic resources such as seeds and genes taken from the people or farming communities that have nurtured these resources. It may also refer to the theft of traditional knowledge from the cultures who have nurtured resources.

Many drugs have been derived from plants used by traditional healers in different cultures. Companies are adopting a hit-and-run tactic of taking away the plant or substances for study, and even if promising results are obtained, nothing is given back to the traditional community or cultures. Many of them have a different opinion that, the profit should be given back to the people who originally discovered them[2–4].

Nargis (*Narcissus tazetta*) is a famous plant having various medicinal properties as documented in ancient Unani classical literature[5]. It is used as solvent (mohallil), absorbent/absorbefacient (jaazib) and jaali (detergent), and also for the treatment of 'balkhora' (*Alopecia areate*) as mentioned in *Khazainul Adviyah* by Ghani. Moreover, it is useful for the treatment of 'Kalaf' (freckles), and bahaq (Ptyiasis) as mentioned in *Al-Qaanoon-fil-Tibb* (AD 981–1037)[6].

A patent application (patent no. 04005448.8) with publication number EP1718142, published on 8 September 2004 is as follows: 'Agents for sequestering serum ageing factors and uses therefore'[7]. The inventor of this application is Kern Dale Dr [US] and the applicant is Nu Skin International Inc [US]. The patent claims that the *Narcissus* product can be used for preventing damage to the skin, treating the damaged skin, preventing a complication of the primary disorder and preventing the secondary disorders, when in all the above cases the complication results from oxidative damage resulting from the generation of reactive oxygen species by arNOX.

Figure 1 shows two prior arts of Unani classical literature against the novelty and inventiveness of the claims of the patent application in which *N. tazetta* has been used for the prevention and treatment of damaged skin. One of them taken from *Al-Qaanoon-fil-Tibb* (*Canon of Medicine*)[6] refers to a description of *N. tazetta* as a single ingredient used