

this respect. In fact, this was recognized long back, and all the three departments – Atomic Energy, Space and Defence have established mechanisms for funding research projects in the academic institutions, although they have not produced commensurate results. The reason is that, a researcher in an academic institution can develop a solution, but he/she cannot develop a product, which is the job of a development group in the research centre.

Industries have an important role to play in this whole scheme. When they are roped in suitably into a development project, development can be considerably faster. They have a lot of experience and expertise in select areas that are almost impossible to substitute by a development group. So development projects have to find means of involving the right industries to accelerate their development cycle. This has not happened so far in the absence of a transparent and reliable mechanism.

The question arises, why do we not hear about the distinction of R and D in the developed world? There are several reasons. They work at the frontier of knowledge where research and development go hand in hand. Often a researcher opens a company to build a product that uses his research results. The academic institutions in the developed world do mainly research work, and they are ably supported by industries that are technologically up-to-date. The hardship of development is more acute in a developing world like ours, where poor infrastructure results in uncertainties on all fronts. Many components have to be developed from scratch, and there are umpteen procedures to be followed for placing a purchase order. That calls for a different set of people who are skilled in handling such non-technical issues and push the project forward. That is why we need the D guys. In fact, they hold the keys to our national development. Only they need to be recognized as such and given their

due. That will also hopefully clear the mess around research groups. They will now have a clear mandate of finding solutions to relevant research issues generated by development projects.

Admittedly, the picture given above is rather simplistic, and may not apply as such to research and development of all kinds and in all areas. An attempt to bring in distinction between R and D positions will surely throw up finer issues of who does what, etc. but it will be a move in the right direction. Meanwhile, hopefully the hurdles of development typical in this part of the world will gradually lessen to make developments faster, easier and more fun, until some day it becomes indistinguishable from research, as in the developed world.

PRABIR K. PAL

*Formerly at Bhabha Atomic Research Centre,  
Mumbai 400 085, India  
e-mail: pkpal.barc@gmail.com*

## Riverscapes also need long-term ecological observatories in India

The recent decision of the Ministry of Environment, Forests and Climate Change (MOEF-CC), Government of India to set up long-term ecological observatories (LTEOs)<sup>1</sup> across the country is a welcome step. Long-term ecological research (LTER) was started in USA in 1980, as a follow-up of the International Biological Programme, but was soon transformed (by 1988) to an international and socio-ecological research programme (ILTSER), with many countries joining it<sup>2</sup>. In India, the forest preservation plots set up in several climatic zones since 1930 for long-term monitoring<sup>3</sup>, were poorly managed and mostly disappeared. A single 50-ha plot set up in dry deciduous forest in Madumalai, Tamil Nadu has been regularly investigated since 1988 (refs 4, 5). However, several calls for a network of LTER sites in different biomes and kinds of ecosystems and for a national repository of data remained unheeded<sup>6-8</sup>.

The Indian LTEO programme centres around a terrestrial landscape approach focusing on protected area network, although coastal and marine systems are

also included. Freshwater ecosystems are represented by the Dal Lake integrated with its Dachigam NP catchment, and to some extent by the theme on fish populations, obviously in the water bodies within the protected forest areas. However, the riverscapes have not received due attention. Riverscapes – a term first used in 1993 by Gopal and Sah<sup>9</sup>, and elaborated in 1998 by Ward<sup>10</sup> – are a dynamic and heterogeneous mosaic of the river systems (including all tributaries) and their floodplains, interacting with the rest of the drainage basin.

It is noteworthy that the LTEO programme is rooted in the national climate change action programme with particular focus on the impacts of climate change. In this context, it should be emphasized that climate change will have more serious impacts on the riverscapes – directly through altering their flow regimes as well as through human strategies for managing their water resources. Greater warming at high altitudes will have a severe impact on the downstream riverscapes. Small reaches within the protected areas and particularly the fish

populations alone, do not represent the riverscapes and cannot reflect adequately the climate change impacts on the riverine ecosystems. Floodplains (including riparian zones) are distinct ecological systems within the riverscapes which deserve special attention for their dynamics in a changing climate. It is necessary that the suitable riverscapes, especially those in the Brahmaputra, Ganga and Indus basins are also included in the LTEO programme. In the case of these rivers, large sub-basins should be treated as one site with several observatories. In this context, I wish to point out also that whereas some level of protection of the sites is necessary for long-term monitoring of ecosystem dynamics driven by climate change, impacts of several other natural and anthropogenic factors need to be examined in the case of the riverscapes. Dal Lake shrank in area due to siltation as even the protection of its catchment in Dachigam NP did not prevent inflow of sediments into the lake. Elsewhere also, the protected areas do not guarantee that the riverine systems will not be affected; rather a river-based intervention within

or outside the protected areas may severely impact them.

1. Bhatt, J. R. and Sukumar, R., *Indian Long Term Ecological Observatories*, Ministry of Environment, Forest, and Climate Change, New Delhi, 2015, p. 52.
2. Aronova, E., Baker, K. S. and Oreskes, N., *Hist. Stud. Nat. Sci.*, 2010, **40**(2), 183–224.
3. Rodgers, W. A., *Indian For.*, 1991, **117**(6), 425–433.
4. Sukumar, R. *et al.*, *Curr. Sci.*, 1992, **62**, 608–616.
5. Suresh, H. S., Dattaraja, H. S. and Sukumar, R., *For. Ecol. Manage.*, 2010, **259**, 762–769.
6. Gopal, B., *Trop. Ecol.*, 1996, **37**, 105–113.
7. Kohli, R. K., Batish, D. R. and Singh, H. P., *Bull. Natl. Inst. Ecol.*, 2005, **15**, 271–276.
8. Tripathi, S. K., *Curr. Sci.*, 2010, **98**, 21–22.
9. Gopal, B. and Sah, M., *Environ. Conserv.*, 1993, **20**, 243–254, 222.
10. Ward, J. V., *Biol. Conserv.*, 1998, **83**, 269–278.

BRIJ GOPAL

Centre for Inland Waters in South Asia,  
41B Shiv Shakti Nagar,  
Jaipur 302 017, India  
e-mail: brij44@gmail.com

## Smile with Science

By – Prakya Sreerama Kumar  
e-mail: psreeramakumar@yahoo.co.in

