Pollution by heavy metals: far-reaching consequences

The recent report by Mitra *et al.*[1] on the occurrence of heavy metals (zinc, copper, lead) in some edible fishes sampled from four stations in the Gangetic delta, appears to be really alarming in view of the fact that these metals could not only exert direct toxic effects on the consumers, but also select metal-tolerant bacteria inside the body of the fishes or their consumers. Genes conferring metal-resistance are most often found to co-occur on the same plasmids with the genes which confer resistance to various therapeutically useful antibiotics. Thus, heavy metals in edible fishes could ultimately lead to the selection of antibiotic-resistant organisms in fishes and humans. Reports on co-occurrence of metal resistance and antibiotic resistance in fish isolates, obtained from different environmental niches, appear from time to time in the literature. The global nature of the problem is evident from different geographic locations of the places chosen for sampling of the fishes. Tolerance to a number of antibiotics and heavy metals was demonstrated in some *Pseudomonas* and *Aeromonas* strains, isolated from nine rainbow trout (*Oncorhynchus mykiss*) farms in Australia[2], and also in some bacterial strains which were isolated from the catfish *Clarias batrachus*, collected from the downstream of the Gomti River near Lucknow[3]. Some strains of *Aeromonas salmonicida* (a fish pathogen) subsp. *salmonicida*, isolated from juvenile Atlantic salmon (*Salmo salar*) aquaculture facilities throughout New Brunswick, and Nova Scotia, Canada were resistant to ampicillin, florfenicol, oxytetracycline, nalidixic acid, streptomycin, sulphonamides and also mercury. All the resistance-conferring genes were found to be located on a single plasmid[4]. The ability of bacteria to transfer resistance-conferring genes to sensitive bacteria in natural environments is well-documented. Hence, presence of heavy metals in fishes may give rise to far-reaching consequences. During a recent study at IGB-Neuglobsow, Germany under a bilateral programme organized by us, resistance to both antibiotics and heavy metals was detected in various combinations among several aquatic isolates, obtained from thinly populated areas of north Germany. Tolerance to antibiotics in bacteria isolated from such pristine environments underscores the grim reality that the problem of antibiotic resistance in bacteria cannot be avoided simply by minimizing the use of antibiotics.

1. Mitra, A., Amin, G., Chakrabarti, G. and Banerjee, K., *Natl. Acad. Sci. Lett.*, 2009, **32**, 357–362.
2. Akinbowale, O. L., Peng, H., Grant, P. and Barton, M. D., *Int. J. Antimicrob. Agents*, 2007, **30**, 177–182.
3. Pathak, S. P. and Gopal, K., *Environ. Res.*, 2005, **98**, 100–103.
4. McIntosh, D. *et al.*, *J. Antimicrob. Chemother.*, 2008, **61**, 1221–1228.

M. K. CHATTOPADHYAY[1,*]
H.-P. GROSSART[2]

[1]*Centre for Cellular and Molecular Biology (CSIR), Hyderabad 500 007, India*
[2]*IGB-Neuglobsow Department of Limnology of Stratified Lakes, Alte Fischerhuette 2, D-16775 Stechlin, Germany*
**e-mail: mkc@ccmb.res.in*

Environmental science and environmental sociology

The editorial on 'Social scientists, natural scientists and sociobiology'[1] offers an excellent perspective to ponder upon. Physical and natural scientists analyse problems in terms of the basic building blocks like scientific principles, laboratory experiments and observation as proof of concept, whereas social scientists adopt hypothesis and people-based models for finding solutions.

Socio–environmental interactions are now becoming vital in the context of global warming. The scientific basis of global warming and global climate change emanates from the basic laws of physics and atmospheric interactions within the earth system. What makes atmospheric dynamics cause global environmental change is scientifically understood, but how environmental sociology interprets it is an entirely different matter. In the climate-change agenda for Copenhagen, we came across suggestions such as limiting the rise in average temperature of the earth by 2°C and defining an upper limit for CO_2 concentration in the atmosphere. Is this a manifestation of environmental science or environmental sociology? Can we control the vast expanse of the atmosphere such that CO_2 concentration at 450 ppmv will cause a rise in temperature of only 2°C, which will continue to be so for a long time? Evidently, more geo-modelling studies would be needed to examine the scientific feasibility of such suggestions. At the same time we should also examine the social factors that cause environmental problems and explore their long-term social impact. Environmental sociology is emerging as a new discipline[2] defined as 'the study of reciprocal interactions between the physical environment, social organization and the social behaviour'.

In the context of climate change, global energy-consumption patterns have come to the centre stage. The topic of energy being highly interdisciplinary, it has been approached by sociologists as a macro or a micro problem of the society. A judgement is made in favour of or against various energy technologies. But there are still daunting challenges as we have to depend on all the available resources to meet our energy requirements. Technology assessment of various energy sources is required. All sources of energy are not acceptable for each and every criterion to be met under sociological, political, environmental and commercial assessment. For example, solar energy though acceptable for socio-political and environmental criteria, is not market-friendly. Coal is acceptable for the market and fulfils sociological needs, but does not fit into the environmental and political agenda. Use of clean coal technologies can help reduce CO_2 emissions, but there still remain challenges.

In climate-related energy technologies, carbon capture and storage (CCS) is emerging as a CO_2 mitigation option. CCS is characterized by three main technologies – first is capture technology where CO_2 is separated from the flue gas of a large power plant or a heavy industry; the second is safe transportation of the captured CO_2 to its place of disposal. The third is storage technology for removal of CO_2 from the atmosphere, which requires its injections in a suitable geo-environment. CCS-enabling technologies are not an important issue for India yet because of their high cost. Whereas CO_2 capture continues to be a major thrust in many R&D laboratories and academic institutions, India's CCS policy does not consider underground storage for safety reasons.

Although latest industry projections suggest that the entire CCS chain may not be commercially feasible until 2025, keeping in view the dominance of coal in India's energy in the foreseeable future, it is desirable that we look beyond carbon capture. Understanding the behaviour of supercritical CO_2 in the subsurface, be it a coal mine or an oil reservoir or a mineral rock, is a scientific necessity to develop a knowledge base about the disposal of the captured CO_2. We need to develop a scientific basis for these technologies[3] through investment in R&D and also take actions for their development/demonstration, as is the case with other energy technologies. There are several risks involved, such as investment decisions, safety concerns and leakage into the atmosphere.

The responsibility of creating awareness about the CCS technologies lies with both natural scientists as well as social scientists to generate scientific understanding and then applying it to get insights from social science research. This would help in creating a bridge between environmental science and environmental sociology to improve our understanding of the various concerns and also our position in the political arena. This could be the way forward towards a policy on this contentious issue.

1. Balaram, P., *Curr. Sci.*, 2010, **98**, 1267–1268.
2. Allan, S. and Gould, K. A., *Environment and Society: The Enduring Conflict*, St Martin's Press, NY, 1994.
3. Goel, M., 26 October 2009; www.financialexpress.com/static/

MALTI GOEL

Centre for Studies in Science Policy,
School of Life Sciences,
Jawaharlal Nehru University,
New Delhi 110 067, India
e-mail: malti_g@yahoo.com

Ethno-medicinal use of a threatened cucurbit from Bihar

Bihar is floristically rich but poorly explored and the complete documentation of its floristic wealth is still awaited. During a floristic exploration in the areas of Katihar district (Bihar), a rare cucurbit *Luffa echinata* Roxb., locally known as *Bindol* (Figure 1), has been observed growing in the wild near Mirchaibari. The plant was first collected by Haines[1] from the neighbouring Purnea district. Thereafter, it has not been observed. A scrutiny of the herbarium specimens housed in herbaria such as CAL, BHAG, BSHC, ASSAM and Herbarium of North Bengal University, revealed that the species was not recorded thereafter from Purnea or any other locality of Bihar. All parts of the plant are bitter in taste and traditionally utilized by the local people as a cure to diabetes. The whole plant is crushed into a fine powder and one teaspoon of it is given with water twice a day to a diabetes patient. The juice of fresh leaves is also consumed as a blood purifier. Fine powder of mature fruits with 'Bael' (*Aegle marmelos*) leaves and Betle (*Piper betle*) leaves is given for dog bite for 21 days once a week. The plant is continuously being over exploited by the local people from the wild and no efforts for its conservation are being made. About 185 individuals were recorded in Mirchaibari area and nowhere else in Katihar. Only 6–10 seeds were recorded from each fruit though the number of fruits ranges from 23 to 35 in each plant. A few seeds were collected from the same vicinity and successfully grown at the botanic garden of T. M. Bhagalpur University, Bhagalpur. A score of 7% for seed germination was recorded under standard growth conditions. The percentage of survival was also considerably low. Habitat destruction due to rapid urbanization in the Mirchaibari area of Katihar is causing a serious threat to the existence of this rare taxon. Considering the medicinal importance of this taxon, conservation efforts should be made soon to protect it in its natural population.

Figure 1. *Luffa echinata* in flowering.

1. Haines, H. H., *The Botany of Bihar and Orissa*, Allard and Son and West Newman Ltd, London, 1921–1924.

M. AJMAL ALI

Department of Botany and Microbiology,
College of Science,
King Saud University,
P.O. Box 2455,
Riyadh 11451, Saudi Arabia
e-mail: majmalali@rediffmail.com