

Priyadarsanan pointed out that at present the world is loudly thinking about decommissioning dams and other barriers for protecting riverine ecology and fish habitats. The country should assure the ecological health of rivers by integrating state of the science ecological thoughts while considering any developmental projects, and developmental decisions should be underpinned by best available scientific knowledge, societal values, preferences and perceptions.

As part of the discussions and deliberations, several recommendations under different themes were compiled.

Science: In India, there is still very little research conducted on how stream ecology is impacted by river-related human interventions and its impacts on riverine fish and fisheries. In the wake of global change, it is important to bring in more clarity as to where the country stands and where it is headed to. The science of ecohydrology which is well-developed elsewhere, needs to be promoted in India for a better understanding about riverine fish responses to flow alterations. A national database on minimum water requirement, e-flow, optimum water release, nutrient flow, etc. for various river systems should be prepared on a priority basis. Other priority areas suggested for science and research include (a) studying life-history traits and their links with cognition, and e-flow requirements for important migratory fish species; (b) designing and developing species-specific fish ladders and fish passes to suit the regional context; (c) developing hatchery life-training proto-

col for fishes that are used in ranching and stock enhancement.

Public awareness: Awareness among public and fishing communities on native freshwater fish species, their biology, behaviour and conservation needs to be improved. These can be made part of school and university curricula as well. Scientists and policy makers need to be sensitized with regard to ecological issues concerning developmental projects and EIA reports.

Policy: The Government of India together with relevant policy think-tanks and National and State research organizations needs to undertake critical assessment and appraisal of river interlinking policies and promote an ecosystem approach to river conservation.

There needs to be in place a clear-cut policy on fish biodiversity, dams and EIAs, as well as a national database on minimum water requirement, e-flow, water release rates, nutrient flow, etc. for various river systems (and for species/groups of fishes). The EIAs conducted should consider biotic, ecological and social impacts. The overall governance mechanisms for riverine fish conservation in India should be improved.

Kerala-specific issues: The Vembanad Lake in Kerala is the largest Ramsar site on the west coast of India, harbouring high biodiversity and supporting rural livelihoods. The Thanneermukkom salt-water barrage constructed to bolster paddy cultivation obstructs the migration and breeding of fish and shellfish, affecting the livelihood of lake-dependent fishers. There is need for a detailed un-

derstanding of species-specific impacts and development of mitigation strategies. There is also a need to develop studies to understand in detail, the floodplain migration of fishes in Kerala and enforce a ban on monsoon floodplain fishery (*ootha piditham*), when spawning individuals are targeted in large groups (often in hundreds) as they migrate en masse for breeding. Many such species that form the basis of monsoon floodplain fishery have a declining population and are listed as threatened in the IUCN Red List.

The river linking and national waterway programmes have the potential to extinguish any leftover fisheries systems in Indian rivers. The panel expressed deepest concerns over the shoddiness in conducting EIAs in the country, and opined that many are based on poor science. The meeting emphasized on the need for improved governance mechanisms for riverine fish conservation in India, and suggested a National Conservation Plan for the fluvial systems. It further recommended that 'fish' should be an important consideration in decision-making on any interventions to the aquatic systems.

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MEETING REPORT

Chemistry for harmonious development and a sustainable future*

Advances in chemistry in recent years have undoubtedly created considerable benefits for humankind which have led to improved health, enhanced quality of life, a better environment and more sus-

tainable development. At the same time, new scientific discoveries may lead to new risks, including the potential for new chemical compounds to be used in chemical warfare. The rapid increase in the use of chemicals and their build-up in our environment also come at a price for human health and biodiversity. Many toxic chemicals have been associated with direct impact on global warming, polluted air and water, causing chronic health problems. As our understanding of chemistry and science increases, so must

our sense of responsibility towards harnessing chemistry for humanity's cherished goal of peaceful, happy and harmonious coexistence. It is also important to raise awareness and educate people regarding various beneficial uses of chemicals, recent innovations, potential risks, trends and practical challenges in the field of chemistry.

In an endeavour to provide a common platform for researchers and students from academia and industry to share their valuable views, experience and

*A report on the UGC-sponsored two-day conference entitled 'National Conference in Chemistry: Environment and Harmonious Development (NCC-2016)' held during 7-8 April 2016 by the Department of Chemistry, Shyam Lal College, University of Delhi at the India International Centre, New Delhi.

research on the peaceful uses of chemistry, a two-day conference was held in New Delhi by Shyam Lal College, University of Delhi entitled 'National Conference in Chemistry: Environment and Harmonious Development (NCC-2016)'. The aim was also to raise awareness about the Chemical Weapons Convention (CWC), an international disarmament treaty which came into force on 29 April 1997, banning the development, production, stockpiling, transfer and use of chemical weapons worldwide. Thirty-five scientific papers and 70 posters were presented by the students and researchers showcasing their latest findings and new developments in the field of chemistry.

Rakesh Kumar Sharma (INMAS, DRDO, Delhi) in his keynote address spoke about the surge in terrorist acts involving hazardous chemicals/materials and chemical warfare agents. He emphasized on proactive integration of chemical intelligence into military doctrine and homeland security. The second keynote address was given by A. D. Bhatt (National Authority for Chemical Weapons Convention (NACWC)). He spoke about NACWC, which was established under the Chemical Weapons Convention Act, 2000 for implementing the provisions of the Convention and was signed on behalf of the Government of India at Paris on 14 January 1993. He apprised the participants that UGC in its letter in 2015, directed all the universities and institutions to incorporate vital issues such as weapons of mass destruction, disarmament and peaceful uses of chemistry in their curricula.

Plenary sessions included presentations by leading scientists engaged in cutting-edge research. The sessions were presided over by eminent scientists like Arun P. Kulshreshtha (Centre for Science and Technology of the Non-Aligned and Other Developing Countries, NAM S&T Centre, New Delhi), J. M. Khurana (University of Delhi, Delhi) and Tanu Jindal (Amity University, Noida). The first plenary session entitled 'Interface of chemistry and biology' discussed how science at the chemistry-biology interface brings the synthetic, mechanistic and analytical powers of chemistry to bear on new and exciting areas of biology. Pawan K. Dhar (Jawaharlal Nehru University, New Delhi) discussed the emerging trends in synthetic biology. He presented his inspiring work on artificially made genes and proteins from non-

coding and not-coding DNA, historically called 'junk DNA'. Ashok K. Prasad (University of Delhi) discussed how biocatalysts are an attractive alternative to conventional chemical ones. He described an environmentally harmonious way to synthesize novel nucleosides, amphiphiles and pseudorotaxanes using enzymes. Prasenjit Ghosh (Indian Institute of Technology Bombay) illustrated a new 'wonder ligand', the *N*-heterocyclic carbenes and their utility in biomedical applications.

The second plenary session was on 'Environmental sustainability' in which Dileep K. Singh (University of Delhi) shared his work on bioremediation of agrochemicals and heavy metals present in the Yamuna and drainage water utilized for irrigation in urban and peri-urban agricultural areas using fungal and bacterial strains. K. K. Sharma (Indian Agricultural Research Institute (IARI), Delhi) informed the audience about the project on pesticide residues being carried out in a network of 15 laboratories since 1984-85 by the Indian Council of Agricultural Research. The project aimed at developing uniform protocols for the safe use of pesticides by recommending 'good agricultural practices'. He also shared that in order to know the status of pesticide residues in market samples, the government has started a central sector scheme, 'Monitoring of pesticide residues at national level' in food commodities and environmental samples like water. S. K. Tyagi (Central Pollution Control Board) discussed about the status, challenges and strategies in air pollution management in India. He stressed on the fact that contribution of every citizen is equally important in reducing air pollution.

The third plenary session was on 'Innovations in green chemistry'. It focused on sustainable methods which seek to reduce chemical-related impact on human health and the environment, by the use of alternative, environment-friendly processes and reaction media called green chemistry. D. S. Rawat and Mahendra Nath (University of Delhi) discussed about novel recyclable heterogeneous catalysts and nanomaterials for the synthesis of a variety of organic molecules of biological importance.

The Chief Guest, Sanjeev Kumar Balyan (Minister of State for Agriculture & Food Processing Industries, Government of India) said that chemistry and biology are the main knowledge sets

necessary to understand and solve environmental issues. The fourth plenary session on the second day of the conference was on 'Science of the total environment'. All forms of life are composed of biomolecules such as carbohydrates, proteins, enzymes, lipids and nucleic acids. Shrikant Kukreti (University of Delhi) unveiled the wide range of effects that the changing environment may have on the chemistry of these biomolecules and thereby to the human health. Radhey Shyam Sharma (University of Delhi) introduced the concept of bioprospecting, which is a process of discovery and commercialization of new products, based on biological resources. He also stressed on the need for ecosystem restoration that is necessary for enhancing the quality of life.

The next plenary session was on the 'Peaceful uses of chemistry'. Anil K. Mishra (INMAS, DRDO) elaborated the ambitious scope of peaceful nuclear energy activities for humankind. He shared his work on the development of several radiopharmaceuticals and MR imaging agents which are an integral component of nuclear medicine necessary for imaging deadly diseases of human origin. There is widespread discussion in the scientific community about how nanotechnology can be used against humankind by concealing weaponized molecular structures with a benign and target-friendly exterior. Rita Kakkar (University of Delhi) revealed how agents of chemical and biological warfare in the hands of terrorists pose a serious threat to mankind.

The conference also became a forum for amalgamation of academia and industry. Rohit Kumar (Guiding Star Digital Publishers, New Delhi) discussed about the emergence of global 'knowledge economy' and its impact on the education system due to the rapid advancement in information, computing and communication technologies. Vanya Rohan Gupta (Chapter Apps Inc, New Delhi) in her talk 'Bringing sustainability and harmony to education' covered the concept of paperless classrooms. With the advent of technology, students can do their homework, take their tests, and download all of their study materials online. She pointed out that going paperless can have a huge impact on the environment.

An open panel discussion with the participants on the 'Role of chemical education in chemical weapons convention'

was steered by A. D. Bhatt. The key findings and recommendations emphasized on the need for every chemist in the world to be aware of the potential of work to be misused, and the steps they can take to prevent this. It was also realized through the discussion that the subject of chemical weapons disarmament provides opportunities to introduce students to the nexus of science and international diplomacy, perhaps inspiring chemistry students to use their scientific training to bring technical insight into policy and diplomacy.

The valedictory address was delivered by Vijender Gupta (Leader of Opposition in the Delhi Assembly). He pointed out that we have reached a threshold level of development in the field of chemistry, where we have to promote a conducive environment as well as ensure harmonious and sustainable development.

The conference concluded with the closing remarks of Arkaja Goswami and Rabi Narayan Kar (Shyam Lal College, University of Delhi). Prizes were given away for the best paper and best poster presentations.

The conference successfully brought together the collective knowledge of academia, industry and the government in order to address the duality of chemistry, the role of chemistry in environmental sustainability, education and outreach, and implementation of the CWC in a broader educational context.

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