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CORRESPONDENCE

Greening earth scientists

Of late, man has acquired the status of a geological agent; modifying landscapes, drainage systems and general climate at a pace much faster than that of nature. Cutting of hills and trees, reclamation of paddy fields that can act as huge sponges in absorbing rain water, plastering of land with concrete and converting vast tracts of natural systems into concrete jungles and altering natural drainage patterns during urbanization have created problems like landslides, floods, lowering of groundwater table, drying up of water courses and increase in the average air temperature in places where these problems never existed before.

Bangalore city which in the past had an abundance of tanks to intercept and store rain water is now facing water shortage, leading to water supply through pipes being limited to certain unearthly hours of the day. Plastering of land and obstruction of natural drainage have caused flooding in the city of Chennai even during small showers. And, the city of Thiruvananthapuram with more than 250 cm average annual rainfall is facing water shortage due to the fast rate of urbanization and the inability to harvest the rain water, 90% of which goes to the sea as surface run-off.

Urban centres are fast becoming huge hot houses due to the rise in the air temperature caused by the felling of trees and the blocking of normal air flow by giant concrete structures. In contrast, places with less concrete and having more trees are much cooler than the nearby cities. What all these mean is that we have dug our own graves due to unscientific land and water management. These problems have come to stay and will only worsen in the days to come.

As earth scientists we can do a lot of things that can make significant and positive changes. In fact it is our responsibility to reorient both research and applied sciences towards socially relevant activities.

What can we do in this regard?

A comprehensive package for urban landscape protection and management can be arrived at by geomorphologists, environmentalists and planners working in tandem. They should also create a mass awareness on these topics. Organizations related to water, like the Central and State Ground Water Departments, State Water Authorities and others can help the government by devising ways to protect water for the benefit of the public. Also they can educate the public on the need for proper water management. Environmentalists should concentrate more on topics like management of urban green cover, and ways to bring down air temperature and air pollution in the cities. Only a concerted effort involving scientists, NGOs, Government officials, people's representatives and the public will bear fruit. Last, but not the least, academic institutions, research labs and NGOs related to earth sciences should encourage more and more people to work in these areas. Let us think in terms of, and bring all the earth scientists under the banner of 'urban geoscience for better living' so that we can put what we learned to better use for the service of humanity.

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NEWS

Sen and Mashelkar elected to the Royal Society

On 14 May 1998 The Royal Society elected forty new Fellows and five new Foreign Members. Two Indian scientists, Ashoke Sen and R. A. Mashelkar are among the newly elected Fellows.

Ashoke Sen, 42, is a Professor in the Mehta Research Institute of Mathematics and Mathematical Physics, Allahabad. He is widely known for his brilliant contributions to unravelling the structure of supersymmetric quantum field theory and superstring theory. He is a leading figure particularly in the application of string theory methods to determine quantum properties of black holes as well as the structure of Yang–Mills quantum field theory.

R. A. Mashelkar, 55, is Director General of the Council of Scientific and Industrial Research. He has made outstanding original contributions to polymer engineering, notably in the modelling of polymerization reactors, diffusion in polymeric media, transport studies in swelling polymers as well as non-Newtonian flows.

In particular his engineering analysis of secondary flows and particle motion/deformation are considered both innovative and pragmatically important.

Srinivasa Varadhan, Professor of Mathematics in the Courant Institute of Mathematics, New York University, is also among the newly elected members. Varadhan has been a central figure in the development of probability theory during the last thirty years. His work with Stroock on the Martingale formulation for Markov processes has changed fundamentally how they are viewed which has proved essential for the study of Markov processes with complex state spaces. In his recent work on hydrodynamic scaling he has since answered some of the difficult questions concerning the approach to equilibrium of large systems with slow modes.

Tree seed science and nursery technology in the conservation of forest genetic resources

The rapid rise in human population and their consequent increased demands for more and more utilization of natural resources have led to the rapid depletion of forest cover and a disturbance in the ecological balance. Conservation of biodiversity and more specifically forest genetic resources is, therefore, becoming increasingly important. Since seeds are the major components of such conservation programmes, it is not surprising that the focus of the annual meet of the 'International Union of Forest Research Organization' (IUFRO) held during 22–25 November 1997 was 'Innovations in Forest Tree Seed Science and Nursery Technology'.

The emphasis of conservation research today, is not only to select superior genotypes from amidst a population of highly variable cross-pollinated species but also to understand the reproductive biology of the concerned species. While a study of the seed development process is necessary to ascertain the right time of seed collection with respect to maturity, vigor and vitality, an understanding of the physiology and biochemistry of seeds helps in developing proper strategies for the storage of the three different types of seeds – 'orthodox', 'intermediate' and 'recalcitrant' and also in developing quality saplings.

The 'recalcitrant' seeds differ from the 'orthodox' ones in their (i) inability to retain viability below a critical level of inherent moisture and also (ii) in the absence of processes or mechanisms which confer protection against desiccation during processing. Thus, storage of recalcitrant seeds is extremely difficult.

Since recalcitrant seeds form the bulk of the plants, which comprise the tropical rain forests that cover almost half of all the plant species in the world, recalcitrant seed biology today is one of the most challenging areas of research.

Seeds immediately after collection contain a mixture of both viable and nonviable seeds and must, therefore, be separated prior to processing and storage. 'Incubated-dry-separate' method is a new technique by which viable and nonviable seeds can be separated in a column of water. This method is based on the principle that, in a mixture, following imbibition, the filled but nonviable seeds dry more rapidly than the filled viable seeds. Drying results in a large differential in seed moisture content or specific gravity and this makes the drier, nonviable seeds to float so that they can be easily separated from the wetter, viable seeds which sink to the bottom. However, even more attractive but non-destructive techniques are the 'Computerized Axial Tomography' (CT) and the 'Magnetic Resonance Imaging' (MRI) which were elucidated by Jack A. Vozzo from USDA Forest Service, USA. In CT, single plane images of the entire seed are stored in computer programs and all consecutive planes are reconstructed into a 3-D model of the seed showing its internal organization. MRI, however, images the mobile proton distribution which in turn represents the amount and distribution of the hydrogen ions of bulk water and fatty acids. By this method, metabolic paths can be followed from point to point inside the seed and the physiology and morphology of the seeds can be clearly understood using different false colours. These methods help in distinguishing the live full seeds from the dead full seeds and the empty seeds.

Drying of seeds up to their level of critical moisture content and the actual process of drying are also important. While drying of 'orthodox' seeds without affecting viability is not problematic, that of 'recalcitrant' seeds may lead to severe oxidative damages. Unlike the orthodox seeds, the recalcitrant seeds require a small amount of 'matrix bound' water for their viability. When this water is lost due to drying, the integrity of membrane is irrevocably damaged and seed viability is rapidly lost. However, according to Patricia Berjak from the 'Plant Cell Biology Unit', University of Durban, South Africa, the time taken for water to be lost is of critical significance to the degree of dehydration that a recalcitrant seed will tolerate. She found that the oxidative damage due to the free radicals generated during drying could be prevented in species like *Ekbergia* by rapid drying.

The second important component of conservation research is the development of scientific and proper nursery techniques for the planting of quality seeds as without it, even heavy investments in the collection, processing and storage of seeds may go waste. Therefore, an understanding of the requirements for seed germination, sapling growth and soil science of the plantation site is essential for the establishment of quality saplings. Today, the use of mycorrhiza in this area is fast becoming a novel approach as was indicated by B. N. Johri, Forest Research Institute, Dehradun.

Biotechnological approaches can contribute greatly to afforestation programmes as superior and elite plants can be mass-multiplied through micropropagation. Moreover, efficient conservation of threatened germplasm through artificial seed production and cryo-preservation is an important technique. However, M. R. Ahuja, Institute of Forest Genetics,