



# ENVIRONNEWS

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## Newsletter

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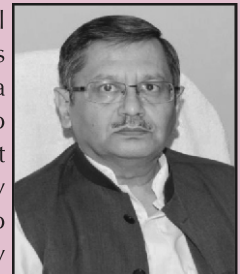
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### President ISEB's New Year Message

**E**nvironews is the quarterly newsletter of International Society of Environmental Botanists (ISEB), which was founded at CSIR-NBRI, on 3rd December 1994. Less than a month after its founding, ISEB launched Environews to disseminate latest scientific information on Environment and Plant Sciences to a wide spectrum of people which included not only researchers and academicians but also non-specialist readers who had a general interest in plants and environment, though they may not follow the complicated scientific data which appeared in specialized scientific journals. The current issue is the 81st issue of Environews, which enjoys a world-wide circulation through its print and electronic editions. ISEB has made commendable progress and won many laurels and international acclaim during the past 20 years which, I need not to repeat here, as it is available on our website: <http://isebindia.com>, which has received over 56000 hits from all corners of the world. After organizing four well attended International Conferences in 1996, 2002, 2005 and 2010, we are set to organize Fifth International Conference on Plants & Environment Pollution (ICPEP-5) during 24-27 February 2015, at CSIR-NBRI, Lucknow. As Director of CSIR-NBRI and President of ISEB, it is my proud privilege to invite you to this broad-based multi-disciplinary Conference. I also seek your help and co-operation in making this Conference even more successful than the earlier ones organized by us. I offer my greetings and good wishes to all members of ISEB and readers of Environews for the NEW Year 2015. Looking forward to your continued support and patronage to ISEB and Environews as well as to CSIR-NBRI, which is the fountain head of many R&D and societal activities organized for the welfare of common man around the globe, without any consideration of geographical boundaries.



**Dr. Chandra Shekhar Nautiyal**  
President ISEB & Director,  
CSIR-NBRI, Lucknow, India

## Happy New Year 2015

President and Members of the Executive of International Society of Environmental Botanists Wish a Very Happy, Fruitful and Prosperous New Year to all Members of ISEB and readers of ENVIRONNEWS

With this issue

Environews enters the Twenty-one year of its publication



## LETTERS

Kindly have the following change of address noted in the Society mailing list:

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**T**he recent report on allowing sand mining in Godavari is disturbing news. Indiscriminate and non-monitored sand mining on several eastern Indian rivers have demonstrated extensive damage to the river bed, change of river courses, damages to the shoreline and negatively impacting aquatic ecosystems impacting local flora and fauna. Most sand mining companies do not follow any standard protocol for excavating sand from the river bottom and being ill or non-monitored, take extreme advantage of the situation in promoting illegal mining activities in collecting more sand than their standard quota is allowed, further deteriorating the environment. Unless stringent surveillance and monitoring could be established along with strong legislation and Safe Operating Procedures with lower impact on the local ecology, flora and fauna, allowing sand mining activities on the Indian rivers could turn out to be a long term ecological disaster.

**Saikat Kumar Basu**

University of Lethbridge  
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**I** gratefully thank you for the invitation to the ICPEP 5. I regret to inform you that I will not be attending the meet. I look forward to visiting Lucknow in the future as it will always be home to me in India since my visit for the first and second ICPEP! I wish the Organizing Committee the very best for the coming event!

Thank you very much.

**Melor Ismail**

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### About Indiscriminate Plant Collection

**I** totally agree with the view expressed by S.K. Basu in ISEB Newsletter of October 2014. As early as in 1991, I had expressed the same concern ("Students' Herbaria, Agents for Destruction of Nature", Current Science, 60:11, 624-625). As a result of that 'Opinion', some of colleagues from other Universities informed me that they had, in their Universities, adopted a policy of making herbaria of only very common plants and weeds. They went a step further and informed their students that removal of endangered and rare species from habitats would be punishable by losing credits in examination. I hope the practice still continues in those Universities and spreads further at the instance of Botany teachers in all the universities in the country.

Our students were given an option of submission of photographs of such plants in their natural habitats. With photography now being easier, thanks to mobile-cameras, this option is easy, practicable and educative. I hope that the current lot teachers manage to get the suggestion incorporated in UGC guidelines for all Botany curricula, possibly with the help of ISEB.

**(Prof.) Sharad B. Chaphekar.**

Hon. Director,

Ind. Inst. Environ. Medicine, Mumbai (**India**)

**I** regret to bother you again with my concern about the IJEB that was assured to appear at the 2015 ICPEP 5. There seems to be no publicity about it, and having waited just over a year to see if the article that I had submitted might appear, there is no word on that either although I have earlier sent e-mail enquiries. I plead with you, can you give me some information in this regard. I have no adverse thoughts about IJEB, but only want an answer to my questions. If there is to be no IJEB, then I must move with alternate arrangements. Thank you for an early response, and my very best wishes for the February ICPEP 5 meeting and symposium. And all the very best to you and ISEB throughout the New Year!

**Richard Crang, USA**

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## WELCOME NEW LIFE MEMBERS

**Dr. Felix Bast**, Assistant Professor, Central University of Punjab, Bhatinda.

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## WELCOME NEW PATRON MEMBER

Central University of Punjab, Bhatinda, Punjab, Established in 2009

Established in 2009, the Central University of Punjab, Bhatinda (CUPB) is a forerunner in the field of path breaking research initiatives and providing innovative and high quality education programmes in Punjab under the dynamic Leadership of JC Bose Fellow Prof.R. K.Kohli FNA, FASc, FNASc, FNAAS. It is heartening to know that the University is at the top amongst the new Central Universities in the country, in terms of research output. ISEB looks forward to having closer interaction with the CUPB in near future.



## NEWS FLASH

### Dr. C. S. Nautiyal Honoured with J. C. Bose National Fellowship

Dr. Chandra Shekhar Nautiyal, Director of CSIR-National Botanical Research Institute (NBRI), Lucknow has been awarded the prestigious 'J. C. BOSE NATIONAL FELLOWSHIP' by the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India. The fellowship is meant to recognize active scientists and engineers for their outstanding performance and contributions. The fellowships are scientist-specific and very selective. The J. C. Bose National Fellowship carries an honorarium of Rs. 25,000/- per month in addition to regular salary. A contingency of Rs. 10 lakhs per annum is provided towards conference participation and other expenses.

This award is conferred to Dr. Nautiyal, for his eminence and contributions in the field of exploring ecosystem friendly approaches utilizing science behind plant-microbe interactions that he has constantly pursued for 3 decades. Dr. Nautiyal has developed novel technologies that have enabled rapid screening and selection of useful plant growth promoting microbes that impart plant tolerance to salt, drought, and pathogenic microorganisms. The outstanding endeavours of Dr Nautiyal in the field of agricultural biotechnology contributed in increasing stress tolerance and enhancing the yield of plants, maximising the economic, environmental and societal benefits to the people of India, which made a difference in the life of millions of farmers. Major spin-off of his contributions has been several patents, publications and a utilization of these technologies by several biotechnology companies nationally and internationally.

In recognition of his distinguished contributions in Science & Technology, Dr. Nautiyal has been bestowed with some of the most prestigious awards. To name a few, CSIR Award for S&T Innovations for Rural Development (CAIRD) 2011; Government of India, for S&T Innovations for Rural Development; Vigyan Gaurav Samman by Council of Science & Technology, Government of Uttar Pradesh; Life Time Achievement Award by the Biotech Research Society of India (BRSI); TATA Innovation Fellowship of Department of Biotechnology (DBT), Government of India; Industrial Medal Award BRSI; the Biotech Product and Process Development and Commercialization Award by DBT, Govt. of India; All India Biotech Association (AIBA) Award, and Vigyan Bharati Rashtriya Puraskar. Additionally,

Dr. Nautiyal is a Fellow of Indian National Science Academy (FNA), New Delhi; The National Academy of Sciences FNASc., Allahabad and National Academy of Agricultural Sciences (FNAAS), New Delhi and member of several learned professional bodies.

Dr. Nautiyal's future vision is to provide best-of-scientific solutions for our country's need based oriented research by adopting an appropriate mix that suits its needs and resource to improve plant stress tolerance and for enhancing the yield of plants that maximises the economic, environmental and societal benefits to the people of India.

### Prof. Varshney honoured

Prof. C.K. Varshney, Professor Emeritus Jawaharlal Nehru University, New Delhi has been appointed as a Distinguished Adjunct Professor at Asian Institute of Technology (AIT) Bangkok. Professor Varshney is one of the founders of ISEB and presently it's Advisor.

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### Outreach Programmes

On November 13, 2014 Dr. S.C. Sharma, Vice President, ISEB delivered a talk on "Bio-aesthetic Planning for Healthy and Happy Life" at the Central University of Punjab, Bhatinda (Punjab). Dr. Sharma explained the benefits of Living with the Nature and Creating the Nature in the Home. Dr. Sharma explained the Science and Philosophy of the Japanese Gardens, which are famous for perfection and meditation. Gardening is the creative hobby and best exercise especially for the Senior Citizens for the Happy and Healthy Life. In the end there was interactive session with the faculty members and students of the university.

On November 20, 2014 Dr. S.C. Sharma delivered a talk on "Bio-aesthetic Planning for Health and Happiness" at the Mahila Vidyalyaya Degree College, Aminabad, Lucknow,

Uttar Pradesh. Dr. Sharma explained the principles of the Bio-aesthetic Planning and benefits to the cross section of the society. Dr. Sharma emphasized the importance for saving and planting the trees which are the lungs especially in the congested areas like Aminabad and Chowk.

After the technical Session Dr. SC. Sharma, Dr. Y.K. Sharma, Head, Botany Department, University of Lucknow, Ms. Kanti Srivastava, ISEB (CSIR-NBRI) and Dr. Pallavi Dixit, Assistant Professor, Mahila Vidyalyaya Degree College Lucknow interacted with the college students and teachers on the environmental problems and solutions with special reference to the Capital City Lucknow. On this occasion an exhibition was organized where the students displayed posters on the theme "Save the Environment for our Survival" and prizes were awarded to the students in various categories.

## Impact of Climate Change on the Adaptation of Plant Species in Western Himalaya

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The Himalaya Mountain is among the most prominent bio-geographical entities that separates Indian subcontinent from Tibetan Plateau. Evolved during the Cenozoic era, Himalaya covers a total area of 750,000 km<sup>2</sup> in an arc of about 2400 kilometers in length to wrap northern Pakistan, Nepal, Bhutan, and the northern and eastern parts of India. The Himalaya harbors 33,050 km<sup>2</sup> of glaciers that give rise to at least eight largest river systems including Ganga, Yamuna, and Brahmaputra and hence this mountain is also known as "water tower of Asia". This mountain system is home to about 25,000 species of plants (~ 10% of the world's total) and acts as 'sink' for carbon dioxide through its green and the forest cover. Himalaya in India covers an area of 0.537 million km<sup>2</sup> with a width of 250-300 km. Importantly, Himalaya houses 13 of the 825 ecoregions of the world. The Himalayan ecosystem in India supports about 50% of the total flowering plants of which 30% flora is endemic to the region. There are about 816 tree species, 675 edibles and nearly 1743 species of medicinal value found in the Indian Himalayan region. Within Indian

region, Himalaya is classified into three major zones: western Himalaya (encompasses administrative boundaries of Jammu and Kashmir, Himachal Pradesh and part of Uttarakhand), central Himalaya (comprises of hills of Uttarakhand) and eastern Himalaya (represented in Arunachal Pradesh, Sikkim and Darjeeling). Western Himalaya has two distinct regions. One region has typical mountainous zones consisting of valleys, mid and high mountainous zone, whereas the other region is trans Himalayan zone that houses cold deserts (in Lahaul and Spiti district of Himachal Pradesh and Ladakh region of Jammu and Kashmir).

Climate change is impacting the mountain ecosystems including Himalaya, by affecting water resources and vegetation. One of the most evident consequences of climate change is warming that is a major driver ecosystem change. For example, global warming of 1°C to 2°C might shift southern boundary in Siberia northward and shrink the areas occupied by tundra and forest/tundra in Eurasia from 20 to 4%. Warming of Himalaya was estimated to be @ 0.04°C-0.09°C/year

wherein Regional Climate Model did suggest the largest warming at highest altitudes in Himalaya. Meteorological data showed a rise of about 1.6°C in air temperature during the century wherein minimum temperature increased at a slower pace as compared to the maximum temperature. Precipitation showed a significant decreasing trend in monsoon precipitation in northwestern Himalaya though winter precipitation indicated an increasing but statistically insignificant trend. Increase in air temperature was possibly a reason for decreasing winter snowfall in some portions of Pir Panjal Range. Plant adaptation studies assume central importance in Himalaya, since vegetation in the region has limited migratory zones; any adverse change in climate might lead to extinction of species, more so since some of the species are at the edge of their spatial distribution.

A change in climate affects plant performance directly and also indirectly by affecting the other associated abiotic and biotic factors. For example, increased air and soil temperature would reduce plant duration, increase the rate of respiration, modulate the pest

population dynamics, affect nutrient mineralization in soils, alter nutrient-use efficiencies, increase evapotranspiration, and affect organic matter transformations in soil and so on. Some interesting questions under the climate change scenario are: which group of plants C3 or C4, will perform better? How the nitrogen fixers versus nitrogen fixers would behave? Will tree species be benefit more and affect the performance of under-story species due to restriction in radiations? Several studies suggested alteration in genetic diversity and species richness towards desirable biospheric properties that would lead to increase in the niche security. A few studies showed exudation of organic matter into the soil leading to stimulation of useful microbes. Such studies in Himalayan zone lead to important conclusions. High altitude environment is often considered akin to that of preindustrial era and hence, though not in very strict sense, studies along altitudinal gradient would serve interesting site to study the impact of climate change on plant performance and response.

#### **Enhancing CO<sub>2</sub> uptake the nature's way: a solution under climate change scenario**

One of the major concerns under the climate change scenario is on how to sequester more CO<sub>2</sub> in the high CO<sub>2</sub> environment and what role the plants could play and how? Low partial pressure of CO<sub>2</sub> at high altitude offer clues. Photosynthesis is one of the major components of carbon sequestration pathway and hence, enhancing photosynthetic efficiency is at least one of the major routes for enhancing carbon sequestration. Interestingly, photosynthesis rate does not exhibit significant alteration with change in altitude in spite of changes in partial pressure of gases. This suggested modulation in photosynthetic metabolism at different altitudes. Radiotracer studies coupled to biochemical and physiological analyses showed that C3 plants recruited phosphoenolpyruvate carboxylase (PEPCase) and a few more enzymes

along with ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco) to capture more CO<sub>2</sub> at low partial pressure of high altitude. Also, such an efficient carbon fixation mechanism would contribute to compensate for the relatively short growing period of the plants at high altitudes. Using the tools of molecular biology, it is possible to transfer the mechanism in crop plants for enhancing CO<sub>2</sub> and it might lead to higher carbon sequestration.

#### **Alleviating the oxidative stress**

Global warming and regional cooling are inevitable under the climate change scenarios. Therefore, intense efforts are directed to dissect the temperature responsive plant processes with the possibility to manipulate the processes in desired plant species. Series of publications showed a negative correlation between the level of oxidative stress and plant growth; the species which experienced lesser oxidative stress, exhibited better growth under the harsh climatic conditions. Particularly, the enzymes such as glutathione reductase and superoxide dismutase (SOD) were identified to be important. Further studies using plants growing at higher elevations (~4500m amsl) yielded a highly efficient SOD that tolerated very high temperature (~121 C) and functioned from sub-zero temperature to >40 C. Crystal structure of the enzyme showed it to be the most compact amongst the reported SODs. The said SOD improved the performance of arabidopsis and potato under drought and salt-stressed conditions, at least by enhancing lignifications of vascular tissues.

Rise in leaf temperature during drought is usual when the leaf temperature can be as high as 45-50°C in the extreme cases. Under such situations production of superoxide radical is to be expected. Since SOD scavenges superoxide radical, there is a need to have the enzyme that would be stable at these temperatures for reasonable periods. Therefore, a SOD was engineered by replacing one amino acid at targeted position to obtain a highly thermostable protein. The engineered SOD in

transgenic plants will confer tolerance to abiotic stresses including high temperature and drought, which are the most prevalent cues during climate change.

#### **A multi-pronged approach for tolerance to environmental cues**

There are efforts to develop plants tolerant to environmental cues or insensitive to climate change. This requires knowledge on transferable genetic machinery. The preceding discussion offered targeted approach, which at times, offers limited tolerance to plants against stresses. Hence efforts are being made for a holistic approach to address the problem. Since plants growing in high altitude are exposed to very "harsh" environment, these provided insight into the adaptive mechanisms for tolerance to abiotic stresses. Such plants have evolved strategies to express: (i) a battery of genes such as those encoding chaperons to protect the metabolic machinery, and (ii) modulate the genes that permit growth and development under stress conditions. Therefore, either suitable transcription factor(s) regulating the expression of target genes or co-expression of multiple genes would be desirable for such manipulations under the control of a vector with suitable regulatory elements involving promoters.

#### **Path forward**

A comprehensive knowledge on the responses of Himalayan flora to climate change parameters is crucial not only to strategize conservation policies, but also for bio prospecting activities. There is a need to establish appropriate infrastructure such as artificial rain plots, and series of meteorological stations in the region.

Efforts on monitoring changes in the past and future will be rewarding. An integrated approach encompassing the fields of ecological genomics, chemical ecology and ecological proteomics will provide fine insight into the plant adaptation mechanisms, particularly when the experiments are carried out in the long term permanent monitoring plots.

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## Orchids: Flagship species for monitoring sensitive global ecosystems

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Orchidaceae is the largest family of flowering plants with ~ 24000 distributed globally and is divided into six separate sub-families: Apostasiodeae, Cypripediodeae, Epidendroideae, Orchidoideae and Vanilloideae. This fascinating family of flowering plants is distributed widely in the tropical sub-tropical belts and some restricted temperate regions of the continents of Asia, Africa, Oceania; and in the North and the Neotropics of the Latin Americas. Orchids survive in a wide diversity of habitats and ecological zones and a spectacularly successful group of flowering plants that have migrated and evolved to slowly become one of the most astounding and diversely distributed families of flowering plants. The species of this family are particularly dominant and abundant in the ecosystems of tropical rainforests and temperate regions with high humidity. The plants are pollinated by mechanical means as well as by several biological pollinators such as small mammals, birds and a wide diversity of insect species. Majority of orchids being epiphytes are abundant on high canopy forming trees of the

forest and hence represent a special niche of the existing forest ecosystem. Orchid flowers are known all over the world for their spectacular form, shape, color and fragrance; and hence have attracted botanists, horticulturists, nursery and greenhouse businessmen dealing with expensive, spectacular and exotic ornamental plants and general public at large. Expensive orchids add grace to a floral bouquet all over the planet. Due to such extreme ornamental values orchids across the world have been exposed to serious over-exploitation, illegal harvest, trade and trafficking exposing several orchids from the tropics and neotropics almost to the verge of extinction. Several anthropogenic factors such as encroachments within forested areas and sensitive ecosystems, cattle grazing, uncontrolled forest fires, timber trade, devegetation, habitat fragmentation, shifting cultivation practices, climate change etc have been impacting orchid populations globally. Since orchids are associated with the canopy forming tree species in any major forest ecosystems in the tropics, subtropics, Neotropics and certain temperate regions like eastern

Himalayas, they represent an unique ecosystem and habitat of their own within a distinct ecosystem. In other words, orchids represent "micro-ecosystem" with their own species, their distinct pollinators and host and semi-host tree species and micro-climatic regimes within broad major, "mega-ecosystems". Hence, they are being currently, potentially exploited by researchers as an important flagship species for monitoring sensitive and general health of a forest ecosystem. If an ecosystem represents a wide diversity (abundant biodiversity) of different orchid species in primary good health and in profuse numbers and are surviving, propagating, pollinating, disseminating, breeding and also producing different natural hybrids, that ecosystem broadly represents a healthy one with less anthropogenic impacts and holds promise for a better future. The orchid diversity can therefore be manipulated as target "flagship" species representing general health and conditions of an ecosystem and hence could easily be regarded as an environmental and ecological biomonitors or as plant biomonitors or phytomonitors. .

## Role of Prokaryotes for Arsenic Reduction and Detoxification in Rice

<sup>1</sup>Afroz Ali and <sup>2</sup>U.N. Rai

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Arsenic toxicity is a well debated topic among the science fraternity and has become a global concern due to its ever-increasing contamination of soil, water and crops.

Arsenic is a class one carcinogen present ubiquitously in the environment. Mining activities, use of Arsenical herbicide & insecticides and irrigation with Arsenic contaminated ground water results in arsenic accumulation in paddy soil, especially

in south and South East Asia.

Arsenic poses a dietary risk for human health. Crops and vegetables grown on the arsenic contaminated soils are responsible for human exposure to arsenic. Accumulation of arsenic in various food composites (potato skin, leaves of vegetables, rice, wheat, cumin, turmeric powder and cereals) is a n e d b e t w e e n <0.0004 and 0.693 mgKg

Rice is particularly efficient in Arsenic

accumulation compared to other cereal crops because of anaerobic conditions of the paddy soil and due to sharing the highly efficient silicon pathway..A number of studies have shown that consumption of the rice contributes a large proportion of the dietary intake of inorganic arsenic, particularly for those subsisting on rice. In addition, arsenic causes significant yield losses due to arsenic phytotoxicity. Moreover much higher percentage is

present in rice straw which is used as cattle feed and provides another entry route into the food chain.

Along with the adverse health effects caused due to the accumulation of arsenic in rice grain our country is also facing a challenge on economic front, India has a great export market of Basmati rice but due to the increasing levels of arsenic in rice the exports are getting affected.

Iran is biggest Basmati rice importer, contributing about 1 million tons which is 32% of total basmati export of around 3.4 million tons in 2012-2013. but in 2014, Iran has modified the accepted level of arsenic content in Basmati rice (150 ppm to 120 ppm).

Long term exposure to Arsenic has been associated with skin, lung, bladder, liver, kidney and prostate cancer. Low levels can cause skin

lesions, diarrhea and other symptoms.

Bioremediation of Arsenic toxicity in rice is one of the major challenges of the scientific community. In the developing countries of south and south-East Asia there is a dire need of development of strategies which are cost effective and at the same time are environment friendly. Development of potential mitigation strategies of arsenic accumulation in grain through manipulating microbial communities is highly promising.

Arsenic biotransformation, mainly reduction, oxidation and methylation in soil rice system have fundamental impacts on its mobility and toxicity. In addition to soil chemical properties (Ph, Eh, metallic oxides, organic matter) micro organism play critical roles in arsenic transformation and mobility in paddy soil. Arsenic species in paddy soil

directly influences arsenic speciation in the rice grain because the methylated arsenic species are mainly derived from the microbial methylation in paddy soil. Arsenic speciation and mobility is also highly affected by the micro flora present in the paddy field soil.

A recent study has identified bacterial strains capable of oxidizing toxic Arsenic into less toxic forms, offering a feasible and affordable solution to the problem of Arsenic in soil and water. Bacterial isolates of *Geobacillus stearothermophilus* could oxidize 30 millimolars of toxic inorganic Arsenic 3 into less toxic arsenate within 24 hrs.

These strains have been found to be more effective than any other bioengineered strains so far. The bioremediation method is cheaper than the metal decontamination method used world wide.

## Ecosystem services and need to integrate them in developing environmental management strategies

R. S. Tripathi\*,

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Biological component of ecosystem comprises organisms that may range from large animals and plants to microscopic bacteria. Man is also a part of ecosystem's biological component. Plants and animals present in an ecosystem interact with one another and with their physical environment. The health and wellbeing of human populations depend upon the services provided by ecosystems and their components - organisms, soil, water, and nutrients. Growth in human population and per capita consumption and growth in the scale of human enterprise have severely threatened ecosystems and the services that they provide. Many human activities have caused disruption of ecosystem processes, reduction in quantity of the products that could be extracted, and have impaired the product quality.

Ecosystem services can be subdivided into five categories: (1) Provisioning such as the production of food, timber, non timber forest products and water; (2) Regulating, such as the control of

climate, carbon sequestration, control of diseases and flood; (3) Supporting, such as nutrient cycles, pollination and dispersal; (4) Cultural, such as spiritual and recreational benefits; and (5) Preserving, which includes guarding against uncertainty through the maintenance of diversity.

Eighty percent of the world's population relies upon natural medicinal products. Of the top 150 prescription drugs used in the U.S., 118 originate from natural sources: 74 percent from plants, 18 percent from fungi, 5 percent from bacteria, and 3 percent from one vertebrate (snake species). Nine of the top 10 drugs originate from natural plant products. Though the focus is more on goods derived from ecosystems, certain fundamental life supporting services are also provided by ecosystems, without which human civilization would come to halt. However, such services are often overlooked. Ecosystem services include benefits that accrue to humans from ecosystems, and from the interactions among various components

of ecosystems, and functional processes operating in ecosystems.

As human population grows, the resource demand imposed on ecosystems and the impacts of our global footprint also grow. Many people have the misconception that the ecosystem services are not vulnerable and will be available for indefinite period of time. But the impacts of anthropogenic stresses are already apparent, and we are now faced with several ecological crises of serious nature. Consequently, society has now come to realize that ecosystem services are not only threatened and limited, but we have also to evaluate trade-offs between immediate and long-term human needs on an urgent basis.

Research agenda on ecosystem services could include the following steps:

1. Measurement of the spatial and temporal scales at which ecosystem service providers (ESPs) and their services operate.
2. Identification of ESPs - species or populations that provide specific

ecosystem services - and characterization of their functional roles and relationships;

3. Determination of community structure aspects that influence how ESPs function in their natural landscape, such as compensatory responses that stabilize function;

4. Assessment of key environmental (abiotic) factors influencing the provision of services

Many ecologists believe that the provision of ecosystem services can be stabilized with increase in biodiversity. It is also believed that with increased biodiversity there would be a greater variety of different types of ecosystem services available to society. Thus the link between biodiversity, species richness, and ecosystem services is important to understand to be able to know how to utilize and conserve resources. Although substantial understanding of many ecosystem services and the scientific principles underlying them already exists, there is still much to learn.

**Management and Policy**

Existing legal policies are often considered inadequate since they typically pertain to human health-based standards that are mismatched with necessary means to protect ecosystem health and services. To improve the

information available, it is necessary to implement Ecosystem Services Framework (ESF), which integrates the biophysical and socio-economic dimensions of protecting the environment and is designed to guide institutions through multidisciplinary information to help evolve direct strategic choices.

Another approach that has become increasingly popular over the last decade is the marketing of ecosystem services protection. Payment and trading of services is an emerging worldwide small-scale solution where one can acquire credits for activities such as sponsoring the protection of carbon sequestration sources or the restoration of ecosystem service providers.

Ecological researches have helped us understand the interconnection and interdependence of the many plant and animal communities within ecosystems. Although substantial understanding of many ecosystem services and the scientific principles underlying them already exists, there is still much to learn. The trade-offs among different services within an ecosystem, the role of biodiversity in maintaining services, and the effects of long and short-term perturbations are just some of the questions that need to be further explored. The answers to such

questions will provide information critical to the development of management strategies that will protect ecosystems and help maintain the provisions of the services upon which we depend. The choices we make today as to how we use land and water resources will have enormous consequences on the future sustainability of earth's ecosystems and the services they provide. In order to convince decision-makers, economic value needs to be associated with many ecosystem services. It should take into account the benefits of E.S., impact of its loss on socio-economic conditions of the people and cost of replacement of E.S. with anthropogenically-driven alternatives. There is a need to develop methodologies that help businesses manage the risks and opportunities arising from their dependence and impact on ecosystems. Ecologists, economists, anthropologists, and experts from other allied disciplines must work out a rigorous set of framework, indicators and data to help integrate ecosystem services approach into public- and private-sector policy processes for developing environmental management strategies to ensure that natural ecosystems can continue to provide the benefits and services that society needs.

**\*Based on the lecture delivered by the author at Lucknow University, Lucknow during 34th Annual Conference of the Indian Botanical Society held in October, 2011**

## NEWS & VIEWS

### Are Plastics Environment Friendly?

Although plastics are employed in myriad applications where they actually conserve natural resources, there are some issues which have been surrounding the material ever since its growth rate increased. These issues mostly relate to the management of waste created by plastics products after its use, mostly in the packaging applications. Apart from the issue waste management, there are some other issues/controversies relating to health, safety and toxicities of certain types of plastics products. The major issues related to plastics could be listed as

below

- Plastics Waste - land area
- Plastics Waste - in the sea water
- Vinyl Chloride Monomer and manufacturing of PVC
- Use of Phthalate Plasticizers in PVC
- Use of Polycarbonate as Baby Feeding Bottle

Most prominent among the above is the issue of waste management. The plastics waste management relates mainly to the waste generated by packaging - the single largest application sector in plastics. The cause is mainly littering habit and inadequate infrastructure for waste management

activity and absence proper recycling facilities preferably close to the place of generation of waste.

Over a period of last two to three decades, many countries have been able to address this particular issue in an appropriate manner and resolve the same to a great extent. However, the issue of plastics waste in sea water is yet to be resolved to the satisfaction of all. According to the United Nation's Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), land based sources account for 80% of marine pollution, rest being from the ships. Although there is conflicting figures on the volume of marine plastics



waste pollution, however there is no denying that the problem is definitely serious. More and more attention and efforts are required to address the issue.

On residual Vinyl Chloride Monomer content in PVC, the controversies have been addressed fully with proper Standards - International as well as country specific, and its effective control through the testing facilities, which are available across the world. On the use of certain types of Phthalates, research work is still continuing for proving the safe use of controversial varieties Phthalates in PVC products for food and medical applications while at least four of five types have already been declared as safe for use. However for certain applications most Nations in the world have imposed restrictions in usage. These are toys and other materials which come in easy reach of children below 3 years of age. Many countries have imposed restrictions on use of Polycarbonate Baby Feeding Bottles due to the 'Bisphenol A' issue although the alleged 'migration' of the basic raw material to the product being packed, beyond the permissible level has not been exclusively proved. In the mean time, alternative plastic material - Polypropylene Random Copolymer is being developed for this application area. In any case, for food contact applications, adequate safety measures in terms of adhering to the National and International Standards are taken. It is clear that plastics protect the environment by conserving precious natural resources and energy. More awareness drives and improvements in developing infrastructure for handling waste especially for the flexible packaging waste is required.

Due to its multifaceted benefits, use of plastics in variety of applications has been increasing at a galloping rate all around the world, including in India. Plastics contribute various benefits to the modern world from providing safe and hygienic packaging materials for food and pharmaceutical products, to conserving Land, Water, Forests and Energy resources to practically in all areas of our life. The list below gives a quick overview of major application

areas of plastics:

- o Agriculture
- o Healthcare/Medical
- o Education
- o Pipes for Water, Gas and Sewerage
- o Building & Construction - Flooring/ Doors & Windows/ Drainage Pipes, Water Storage Tanks, Construction Linings etc
- o Cables - Electrical and Telecommunication
- o Electrical & Electronics Equipments
- o Thermal Insulation
- o Automobile, Aviation & Railways
- o Packaging
- o Household
- o Furniture
- o Toys & Others

Some of these applications are for long time use and some for short term. Packaging is the single largest sector of applications of plastics which account for about 35% - 40% of consumption globally. Consumption pattern in India is similar. Flexible packaging applications are mostly for short term use. Management of waste created by the discarded used plastics items, especially the ones used for flexible packaging applications has become a challenging task, more so in the developing countries of the world.

Developed countries have established effective infrastructure for the management of plastics waste of all kinds by adopting proper collection system and different recycling technologies. However in the developing countries the general trend is to opt for selective collection of some types of plastics waste, which are easy to recycle by Mechanical Recycling Process (referred later) abandoning a large chunk of plastics waste, which are difficult for recycling.

These find their way to the landfill or simply remain in the surroundings, creating an environmental issue (choking of drains or creating other health issues). New technologies and economics have come to play an important role in plastics recycling. When we talk about plastics recycling, it principally refers to 'Recovery', which is divided into 'Material Recycling' and 'Energy Recovery'.

Various options for plastics recycling / recovery have been described by the International Organization for Standardization (ISO) in its Standard: 15270:2008.

The choice between Mechanical Recycling, Feedstock Recycling or Energy Recovery will depend on the types of plastics waste and the relative ease / difficulty in total or partial segregation of different groups of plastics materials from each other or from other waste materials / contamination.

Plastics consume least energy for conversion in to final product. Any process which requires less energy is always categorized as environment friendly.

**Source:** *Envis Eco-Echoes*

### European fire ant impacts forest ecosystems by helping alien plants spread

University of Toronto, Canada researcher's Canada have found that the European fire ant, *Myrmica rubra*, disperses seeds of both native and invasive plants, but it does a much better job of helping an invasive plant to spread. Ecologists think invasive species might help each other to proliferate, but there are few good examples. They talk about 'invasional meltdown,' because ecosystems could be very, very rapidly taken over by invasive species if invaders help each other out. The results suggest that invasion meltdown could be happening right under our noses.

The team of researchers created artificial ecological communities -- mesocosms -- inside 42 small plastic children's swimming pools and filled each pool with soil and planted four species of spring wildflowers -- three native species and one invasive species: They then collected colonies of either the European fire ant or a native woodland ant and added the colonies to the pools. The ants picked up and moved seeds of these plant species and it was found that the pools with the invasive ant were overrun by the invasive plant, but pools with the native ant had lots of native plants. The invasive ant moved lots of seeds of all four plant species, but the

invasive plant took advantage of being dispersed more than the other species and recruited in very large numbers. Unfortunately, as a result of humans rapidly moving species around the globe through trade and traffic, most ecosystems are now home to numerous invasive species. The finding that multiple invasive species can accelerate invasion and cause ecosystems to become dominated by invasive species is a troubling one. Invasive species are a leading threat to natural ecosystems, and can have impacts on society. Research on how ecosystems become invaded and the consequences of invasion is important. It sets us on the right path to develop solutions to reduce the spread and impact of these harmful species.

### **Air pollution cuts India's crop yields by almost half**

Ground-level ozone is damaging plants' leaves and black carbon is reducing the amount of sunlight they receive. Both pollutants are also damaging human health.

In a new study, researchers have analyzed 30 years of data on yields of wheat and rice alongside data on air pollution and climate in India, and concluded that significant decreases in yield could be attributed to two air pollutants, black carbon and ground-level ozone.

Comparing crop yields in 2010 to what they would be expected to be if temperature, rainfall and air pollution remained at their 1980 levels, it was found that crop yields for wheat were on average 36 per cent lower than they otherwise would have been, while rice production decreased by up to 20 per cent. In some higher population states, wheat yields were as much as 50 per cent lower.

Up to 90 per cent of the decrease in potential food production seems to be linked to air pollution, while changes linked to global warming and precipitation levels accounted for the remaining 10 per cent.

Black carbon is made up of tiny soot particles and emanates mainly from

combustion in rural cookstoves, but also comes from diesel exhausts. Ozone is a secondary air pollutant from precursor pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs) reacting in the atmosphere in the presence of sunlight. The sources of NOx and VOCs are primarily motor vehicle exhaust, industrial chimneys, and chemical solvents.

Ground-level ozone and black carbon are damaging to human health, contributing to premature deaths. Both are known as short-lived climate pollutants that exist in the atmosphere for weeks to months, with ozone damaging plants' leaves and black carbon reducing the amount of sunlight they receive.

"While temperature's gone up in the last three decades, the levels of smog and pollution have changed much more dramatically," says Jennifer Burney, an environmental scientist at the University of California, San Diego, and co-author of the paper, published in the journal *Proceedings of the National Academy of Sciences*.

"But this was the first time anyone looked at historical data to show that these pollutants are having tremendous impacts on crops."

The results are specific to India's seasonal patterns, the crops, and its high pollution levels, but may extend to other places with similar problems, such as China.

Measures such as improved cookstove technology for rural areas, cleaner energy production and particle filters on diesel vehicles in urban areas, could go a long way towards reducing the damaging impacts on both agricultural yields and health.

**Source:** *The Guardian, In Acid News*

### **How will climate change transform agriculture?**

Climate change will require major transformations in agricultural systems, including increased irrigation and moving production from one region to another, according to the new study, published in the journal *Environmental Research Letters*. The new study by

IIASA researchers provides a global scenario analysis that covers nine different climate scenarios, 18 crops and 4 crop management systems, as well as the interactions between crop production, consumption, prices, and trade. There is a lot of uncertainty in how climate change will impact agriculture, and what adaptations will be needed. In line with earlier results, the study finds that the impacts on crop yields of changes in climate, such as increased temperature, changing precipitation levels, along with the increased CO<sub>2</sub> atmospheric concentration (which has a fertilizing effect on plants), could lead to anywhere between an 18% decline in global caloric production from cropland, to as much as a 3% increase by 2050. This biophysical impact varies widely across regions, crops, and management systems, thereby creating opportunities for adaptation at the same time.

The results confirm that the choice of the climate model used for estimating changes in climate largely shapes adaptations such as moving production from one region to another. But it also shows the importance of how regions are interconnected through trade: for example, in Latin America, where yields are projected to decrease in all scenarios, cropland could increase in some scenarios due to increased net exports to North America. In Europe, where yields are expected to increase due to climate change, cultivated land could decrease depending on the scenario, due to limited export opportunities.

The study also reiterates the importance of limited water resources for future food security in a changing climate, showing that in a large part of the world, increases in irrigation larger than 25% may be required. It is known for a long time that changes to rainfall are a major uncertainty. This study shows how important irrigation will be as an adaptive measure, but also how sensitive it is to different climate scenarios.

After decades of global research efforts,

scientists are only starting to understand the implications of climate change for the future global food system. We need to explore new and uncertainty-proof paradigms for long-term decision-making, and we also need a much better understanding of how to manage crucial resources such as water, which may become dramatically scarcer much earlier than previously thought. "Modeling tools are key to generate the knowledge for restraining climate change impacts on food security within acceptable boundaries without increasing the pressure on our resources."

#### 2014 Hottest year for UK since 1910

2014 was the hottest year for the country dating back to 1910. The average temperature for the year was 9.9 degree C, some 1.1 degree C above the long term average, and making it warmer than the previous record year of 2006 (9.7 C). In a worrying revelation, the latest figures mean that eight of the UK's top hottest years have occurred since 2002. Looking in more details across the UK, it was the warmest year on record for all countries and regions apart from Northern Ireland - which had its joint third warmest year behind 2007 and 2006. It was also within the 20 wettest years in England and Wales Precipitation series which dates back to 1766.

#### Ancient African tree Baobab

The baobab tree is an important, nutritious food source for local people in many African countries, and it has the potential to increase the incomes of local communities, particularly women. To assist in the process of domestication and popularization of this wild food tree, Bioversity International and the World Agroforestry Centre (ICRAF) have developed the publication *Descriptors for Baobab*. Descriptors are a standardized international system that define the different characteristics of a species and allow scientists all over the world to accurately assess the genetic and morphological diversity in its genetic resources.

.Baobab (*Adansonia digitata* L.) is an

important multipurpose food tree of the semi-arid and sub-humid zones of sub-Saharan Africa, including countries in western Africa and eastern Africa. The remarkable, long-lived baobab tree has a short, swollen trunk, wide-spreading branches and a large, round canopy. Almost all parts of the baobab are useful for human beings, with fruits and leaves being the most important for food and nutrition security of local communities. The naturally dry, whitish fruit pulp has five times the vitamin C concentration of an orange, and is high in minerals such as calcium, magnesium and iron. It can be eaten fresh or processed into porridge, juice, jam, ice cream and sweets. The seeds are rich in protein and fat and can be roasted and eaten as a tasty snack or pressed into oil for consumption and industrial use, particularly for cosmetic products. The leaves have high protein, beta-carotene and iron content and are used fresh as leafy vegetables or dried and powdered as a soup ingredient.

The production of baobab pulp and leaves is almost entirely based on trees growing naturally in forests and woodlands or in farmers' fields. As in other undomesticated tree species, there is a high variability among wild baobab trees in valuable characteristics such as the number and size of fruits, proportion of pulp from the whole fruit, taste of pulp and nutrient content of pulp, seeds and leaves. This descriptor list will help in the domestication and cultivation of the species that is necessary to sustainably develop baobab value chains and meet the growing demand from local and international customers for high-quality baobab products.

#### Saving Our Soils and Climate with Biochar

Biochar is a naturally occurring, fine-grained, highly porous form of charcoal derived from the process of baking biomass-and it's been associated with fertile soils for some two thousand years. Biochar is found in soils around the world as a result of vegetation fires and historic soil management practices. Intensive study of biochar-rich dark

earths in the Amazon has led to a wider appreciation of biochar's unique properties as a soil enhancer."

Researchers have been hard at work perfecting their own methods for manufacturing biochar by baking biomass in giant oxygen-free kilns. The resulting biochar can then be used as a soil amendment to help restore tired, compromised farmland, not to mention contaminated industrial sites, all the while taking carbon dioxide out of the atmosphere. A liquid by-product of the biochar production process can also be converted into a carbon-neutral "biofuel" that can displace other carbon intensive fuels.

Farmers can layer biochar into their fields where it becomes part of the soil matrix and helps retain water and essential agricultural nutrients like nitrogen, phosphorous and potassium. It is soil reef upon which abiotic and biotic phenomena happen. Farmers like the fact that using biochar can lower their water and fertilizer bills as well as yield more and better quality agricultural products-leading to better market performance overall.

Beyond agriculture, biochar can also be used to clean up polluted land. For example, if we have a mine that has contaminated soil adjacent to it, biochar will remediate soils. Biochar also makes for an excellent filtration medium. Activated charcoal has been used for millennia as a filter mechanism, and so there is discussion in the biochar community that may be the first step is we'll use it as a filtration media, and then we'll move to agriculture as the cost of production of biochar comes down.

"As far as environmentalists are concerned, the greater the demand for biochar the better, given the fact that it is a potent storage mechanism for carbon dioxide that would otherwise head into the atmosphere and contribute to climate change. "The carbon in biochar resists degradation and can hold carbon in soils for hundreds to thousands of years.

**Source:** *International Biochar Initiative; Full Circle Biochar.*



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9-12 March 2015; Dhaka, Bangladesh  
Contact person: Dr. Selmin Jahan  
E-mail: info@icuh2015.org  
Website: http://www.icuh2015.org

### Save the Planet - Waste Management, Recycling, Environment,

6-th South-East European Conference and Exhibition  
11-13 March 2015; Sofia, Bulgaria  
Contact Maya Kristeva,  
22, Pobeda str., Plovdiv 4003, Bulgaria;  
E-mail: office@viaexpo.com  
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### International Conference on Energy Economics and Environment

27-28 March 2015; Greater Noida, India  
Contact: Prof. Jay Singh  
E-mail: jays.1283@gmail.com  
Website: http://www.iceee.in/  
TMREES - 2015

### 23rd European Biomass Conference and Exhibition

01-04 June 2015; Vienna - AUSTRIA  
http://www.eubce.com Contact Chiara Benetti  
Email: pressoffice@etaflorence.it.

### 5th International Conference on Environmental Pollution and Remediation

15-17 July, 2015, Barcelona, Spain  
Contact person: Cecilia Leong  
TBD, Barcelona, Spain  
E-mail: info@icepr.org  
Website: http://icepr.org/

### 14th International Symposium on Aquatic Plants

14-18 September, 2015; Edinburgh, Scotland.  
Contact: Dr Jonathan Newman  
E-mail: jone@ceh.ac.uk  
Website:  
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