ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

HAPPY NEW YEAR 2004

*President and members of the Executive of International Society of Environmental Botanists wish a very Happy, Prosperous and Fruitful New Year to all patrons and members of ISEB and valued readers of '**Environews**'.*

*With this issue, '**Environews**' enters in the tenth year of its publication.*

- Informative news, views and popular articles/write-ups on current environmental researches/issues are invited for publication in ENVIRONEWS.
- Environews is published quarterly on the first of January/April/July/October; and is supplied free to all members of ISEB.
- Environews is also supplied in exchange for scientific literature published by reputed organisations.
- All correspondence should be addressed to : **The Secretary, International Society of Environmental Botanists,** National Botanical Research Institute, Lucknow-226 001 (India).

LETTERS

Many thanks for the ***Environews*** of October 2003. It provides some very useful articles and information. I must congratulate you and your colleagues for continuing to maintain excellent standard of the Newsletter.

Dr. Anupam Varma
National Professor
Advanced Centre for Plant Virology, Division of Plant Pathology
Indian Agricultural Research Institute, New Delhi – 110 012, India

I found October 2003 issue of ***Environews*** quite interesting and useful. I was pleased to see the forthcoming event of Kathmandu University the "International Conference on the Great Himalayas"also being included. Thank you for your support.

Dr. Subodh Sharma
Department of Hydrobiology, Kathmandu University
Kathmandu, Nepal

I have seen ***Environews*** of October 2003 (Vol. 9 No. 4). It contains educative and interesting articles on plants and environmental pollution, global warming, plastics recycling, biotechnology and news and views, which make an interesting reading.
Kindly accept my hearty congratulations for preparing an excellent newsletter on environment. You and your organization are doing a great service to society and country by organizing studies on environmental problems and creating general awareness amongst common people about the need of preservation of environment.
I pray to God to bless you with success in your endeavours.

Jagdish Gandhi *
Manager
City Montessori Schools, Lucknow, India
(**Mr. Gandhi is the recipient of UNESCO Prize for Peace & Education 2002. His organization holds the Guinness World Record as the World's largest City school with over 26,000 students on roll*).

I just received the latest issue (October 2003) of ***Environews***. Thanks. Since our semester started, I have been extremely busy with teaching. In addition, I have to travel to Washington, DC for a conference where I am to give an invited lecture on "Ammonia". I have to organize materials this weekend for power point presentation at the conference. So, things are hectic over here.

Prof. S. V. Krupa
Department of Plant Pathology
University of Minnesota St. Paul, MN, U.S.A.

I always remember with great pleasure my visit to India and the ICPEP-2 Conference which I attended in Lucknow. I, and my colleague Dr. I.M. Kravkina had sent our manuscript to you after incorporating necessary corrections in July. Could you let me know if our paper will be in the Proceedings of ICPEP-2 and when?

Dr. Irina V. Lyanguzova
Botanical Institute, Russian Academy of Science
St. Petersburg, Russia

Recently I had the opportunity of viewing ***Environews***. I represent Centre for Resource Education – NGO based at Hyderabad. We are organizing two workshops on 'Principles and practices of eco-industrial development'. This event is being organized in association with Administrative Staff College of India and the State Pollution Control Board. We are looking for people who could make presentation on remediation of chemically contaminated soils/lake silt due to industrial pollution. I request you to help us in identifying the resource person in this regard. Please extend your co-operation.

B.V. Subba Rao
Centre for Resource Education,
Hyderabad (A.P.), India

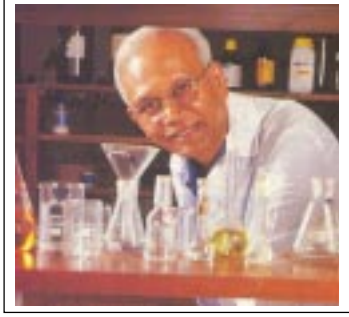
With profound grief and sorrow I wish to inform you that my son, Ketu Sheth, aged 34 years, passed away on 8 September 2003 in a Mumbai hospital. At the hospital it was detected that he was suffering from Kidney failure. Kidney biopsy showed that he had extensive damage of both the kidneys. Doctors opined that this condition may also be caused due to heavy metal poisoning. This made us think whether in the past he had taken any unusual medicine. We came to know that he had taken some herbal preparation given by a physician at Mahabaleshwar (Maharashtra State) when he had visited that place few months before. This medicine was prescribed to him for his complaints of tonsillitis and constipation. Though the medicine he had taken was not available, we knew the name and address of the doctor who had supplied the same. So we telephoned him to send the same medicines again without informing the doctor about the current problems of my son. This doctor sent the same medicines through courier, which was delivered, to us at Mumbai. We got the medicines analyzed and were informed by experts that it contained extremely high levels of metals, like lead, arsenic, mercury and copper.

The laboratory tests of these powders and tablets showed the following results: Arsenic 7.5 ppm; Lead 11.64 ppm; Cadium 1.08 ppm; Copper 17.00 ppm; Mercury 4,000 to 7,000 ppm in two different sets of tablets.

We strongly suspect that the medicines taken by my son might have contained the same and these metals could be the possible reasons for this Kidney damage, though we do understand that it is very difficult to establish the same. We have all the respect for all the branches of medical therapies, however, we would like to appeal to all of you to be careful while taking medicines, which are branded as "Herbal Medicines", "Native Medicines", "Faki", etc., which are claimed to be without any side effects. Please get them checked from experts before taking them.

Vinod M. Sheth
8-A, Woodlands, 67, Peddar Road,
Mumbai - 400 026, India

NEWS FLASH



Dr. R.A. Mashelkar, Director General, Council of Scientific & Industrial Research has been honoured with the prestigious 'Model of Engineering Excellence' medal by the World Federation of Engineering Organizations, Paris (WFEO) for his outstanding contributions to the practice, theory, and public status of engineering. WFEO Medal is presented every two years.

Dr. Mashelkar is the first Indian to receive this prestigious medal.

SAVE GANGA YATRA–THIRD PHASE

A team of scientists from NBRI, Lucknow consisting of Drs. R.D. Tripathi, U.N. Rai, Sanjay Dwivedi, Mukta Singh and Messrs. V.S. Baghel and M.K. Shukla participated in Save Ganga Seminar cum Panel Discussion held at Banaras Hindu University, Varanasi during 22-23 November 2003. The seminar started with Ganga Pujan at Assi Ghat under the leadership of Mr. Tushar Gandhi, Dr. Subba Rao and Swami Gayananand Saraswati. Eminent Ghandhian Activist, Mrs. Rama Rauta was the Convener of the Save Ganga Movement. A rally started from the Ghat, which ended at BHU, in which thousands of students participated.

Many distinguished persons, scientists, intellectuals, social activists spoke on the problem of pollution in Ganga and its management. Dr. U.N. Rai, a senior scientist at NBRI and a Life member of ISEB, while participating in Panel Discussion threw light on the causes of increasing pollution in Ganga and failure of Ganga Action Programme. Dr. Rai emphasized the need for launching a massive tree plantation programme on the banks of river Ganga from Gangotri to Ganga Sagar involving local people and NGOs. He further suggested that constructed wetlands should be developed along the bank of Ganga for the treatment of various sewage and industrial wastes entering the river Ganga.

Dr. R.D. Tripathi highlighted the work carried out at NBRI to check the pollutants at source and their treatment through various phytoremediation techniques. He emphasized development of bioremediation systems comprising efficient bacterial strains to remove metal pollutants present in sewage and industrial/ domestic wastes for ecological restoration of the river and improving water quality. An integrated bioremediation system comprising of efficient microbes and plants will be developed to manage the Ganga pollution.

Prof. Madhoolika Agrawal of the Department of Botany, Banaras Hindu University and a member of the Executive Council of ISEB, was the organizer of the

Panel Discusion at BHU.

Dr. R.D. Tripathi, a senior scientist at the National Botanical Research Institute and an Executive Member of International Society of Environmental Botanists has been nominated, a Member of W.H.O. Expert Group for International Agency for Research on Cancer (IARC) Monographs on the 'Evaluation of Carcinogenic Risks to Humans' by 'Lead and Lead Compounds'. First fmeeting of the group will be convened during February 10-17, 2004 at IARC, Lyon, France.

Prof. Ms. Chitralekha Chatterjee of the Department of Botany, Lucknow University and a Life member of International Society of Environmental Botanists, has been honoured with the '12th International Commemoration Award 2003' by the Society of Soil Science of India, New Delhi. It is for the first time that a scientist from a non-agricultural university has won this award.

Dr. Mrs. Kaiser Jamil, Head, Department of Genetics, Mahavir Hospital & Research Centre, Hyderabad has been honoured with the 'National Achievement Award for Corporate Leadership' by the International Achievers Development Organization. The Award is given to honour the people and organizations for their outstanding contributions to Society and for national and corporate leadership. An eminent environmental biologist, Dr. Jamil had retired as Deputy Director, Indian Institute of Chemical Technology, Hyderabad.

WELCOME NEW LIFE MEMBERS

Dr. Rakesh Tuli, Senior Deputy Director and Coordinator, Molecular Biology & Genetic Engineering Division at the National Botanical Research Institute, Lucknow has joined ISEB as a Life Member. A well-known plant biochemist and molecular geneticist of international fame, Dr. Tuli is a Fellow of all the leading Scientific Academies of India

While working at Bhabha Atomic Research Centre, Trombay, Mumbai, Dr. Tuli had cloned the first agriculturally important gene in India. It was the commonly known Bt-gene, that codes for an insecticidal protein ä-endotoxin found in nature in the soil bacterium *Bacillus thuringiensis.* Under his able leadership, NBRI has recently licensed two transgenic cotton lines expressing Bt -genes to a Consortium of seven leading Indian seed companies. The resultant cotton hybrids will have a wide umbrella of protection against bollworms which are serious pests of cotton and cause an estimated annual loss of several hundred crore rupees in India.

Dr. D.D. Tewari, Reader, Department of Botany, M.L.K. P.G. College, Balrampur, Uttar Pradesh has joined ISEB as a Life Member. Dr. Tewari had made significant research contributions on algae and water pollution.

AIR QUALITY RESEARCH AND EDUCATION: AN INTERNATIONAL PERSPECTIVE* (A COMMENTARY)

S.V. KRUPA

As socio–political and economic conflicts continue to escalate at the global scale, so too is the level of our awareness of the needs to conserve energy, reduce air pollutant emissions, and protect human health and welfare (the environment) against the adverse effects of poor air quality. However, the traditional view of addressing one environmental issue at a time (acidic rain, ozone, etc.) is largely intact. This compartmentalized view is primarily a product of our inability to address the integrative processes and products of the atmosphere as a whole and their impacts on life and material at the surface. Clearly this limitation is due to the technical complexity and major financial support required to conduct the needed studies. A second limitation is the critical requisite to assemble and develop cooperation among scientists representing many scientific disciplines. In this context, because of the competitive nature of securing funding for research, scientists in the U.S. and elsewhere in Europe continue to operate on a disciplinary basis, addressing single issues such as elevated levels of CO_2, O_3, UV–B radiation or atmospheric deposition of nitrogen. Environmental issues such as "acidic precipitation" and "tree decline" have been used to conduct numerous fragmented research studies, ending in indecisive and/or less than dramatic results. In comparison, with the rise of democratic governance in many countries previously ruled by communistic principles and the present openness in those nations, evidence is starting to indicate that human populations may have been exposed for years to relatively high concentrations of various toxic chemicals in the atmosphere (complex, persistent organic pollutants, trace metals, etc.) and through their accumulation in consumed plant products.

There are clear examples of the adverse effects of poor air quality on human health (e.g., particulate matter) and the environment (e.g., ozone). Conversely, at least for the moment, there is evidence that increases in the concentrations of certain atmospheric constituents, for example CO_2, can benefit agronomic ecosystems, when other growth regulating factors (e.g., nutrients) are not limiting. In contrast, such elevated CO_2 levels can adversely impact fragile ecosystems such as the tussock tundra. There is also evidence to show that elevated levels of CO_2 and O_3 combined can offset their respective beneficial and negative effects on plants. Such outcomes are not at all understood when other growth regulating factors are considered. Thus, there is a need for a holistic understanding of the complex and dynamic interactions between the multiple factors of the real world and sensitive subjects responsive to poor air quality. It is important to realize that simply because many of us look for the simplest answer to complex real world problems, it does not necessarily mean nature must cooperate. Because of this, as long as we approach integrative environmental problems with tunnel vision, we will continue to state the frequent conclusion "more research is needed" to understand the problem and the corresponding solution. This highlights the conflict between those who believe in, "wait and see, because we need more data" and those who believe in, "why wait until a measurable human health or environmental impact occurs; control the potential cause now." Cost–benefit tradeoffs represent a critical underpinning in this controversy.

Mitigation: Mitigation has been the most frequently used approach after the fact, to improve air quality. In general this approach is very costly from an economic perspective and thus, cost–benefit tradeoffs have played a major role. Air pollutant emission control technology and their application have essentially been the result of environmental laws or legislation, themselves a consequence of scientific and/or public pressure. At the present time emission controls are largely in use in developed countries. Developing nations have not readily embraced this view due to the significant population growth in those countries, poor standards of living and economic pressure.

Although at the present time developed countries like the USA are the largest emitters of chemical constituents such as CO_2 on a per capita basis, future environmental laws may restrict such emissions through mitigation. In contrast, as we move forward in the 21st century, developing nations may assume the role as major emitters of air pollutants. An example in question is the increasing ozone problem in the Valley of Mexico over the last two decades and the converse decline in ozone in the Los Angeles area over the same period. Similarly, in my presentation at **ICPEP (International Conference on Plants and Environmental Pollution)-2, Lucknow, India (2002)**, I showed satellite radiation (light) reflectance imagery from NASA (National Aeronautics and Space Administration, US) demonstrating smog over the entire northeast India. There are many other comparable examples.

Adaptation: Improvement of air quality through adaptation to modified lifestyles is in general an approach practical to developed nations, but has not always been successful. A prerequisite to the strategy of adaptation is *"environmental literacy"*. While mitigation involves a specific source or sources, adaptation requires entire societies to change lifestyles. For example, using more energy efficient lamps and indoor climate control systems across all individual homes, businesses, etc., would reduce energy demand and thus, lessen power production. Adaptation can only be effective if the required change is practiced across the board. Public respond to monitory incentives and in the US, energy industry has attempted to use such an approach to attract public attention. In contrast, as with mitigation, due to economic pressures and environmental illiteracy, adaptation has not been

successfully tested in developing countries. In many urban centers in developed nations, significant progress is underway to deploy mass transit systems. Such systems are prohibitively expensive for developing nations, particularly if the infrastructure is unsuitable. Most importantly, a problematic approach is practiced in developing countries, where for example, automobiles from the 1950s and the 1960s (use leaded gasoline) are still in operation through continued repair of essential mechanical parts. This is a reality. Most disconcertingly, there is a similar, but sophisticated problem in the US. Use of Sport Utility Vehicles (SUVs) by the public is on an exponential rise. At the moment these vehicles are classified as trucks and thus do not have to conform to the emission standards of a sedan. By their size alone and standing high above the road, they are not only a hazard to people driving traditional automobiles like myself, they also emit 7% more CO_2 than a regular car. There has been little, if any effort in the US to educate the public regarding this problem, likely because of the profitability of the private sector. However, because of increasing backlash about traffic safety, now the manufacturers have expressed intent to lower the height of those (new) vehicles, but not necessarily their emissions, although regulatory pressure is mounting as in California.

Prevention: Prevention is better than cure. Particularly in the U.S., "*pollution prevention*" has been the theme of the 1990s. Pollution prevention requires changes in process technology. A simple example involves brick manufacturing. Conventional production of "bright red" brick can result in the emission of gaseous, toxic hydrogen fluoride gas. The manufacturing of "whitish–pink" bricks that contain high levels of calcium or an alkali would essentially absorb the hydrogen fluoride, although the color or the salability of such bricks has not gained public acceptance. However, resolving one type of problem can contribute to another environmental issue of concern. Use of oxygenated fuels (e.g., ethanol mixed with gasoline) would lead to more complete fuel combustion and thus, reduced carbon monoxide (toxic to humans and animals), but increased carbon dioxide (a greenhouse or global warming gas) emissions from automobiles. These types of contradictory phenomena can cause difficulties in the strategies applied in "pollution prevention." Yet, significant and successful progress has been made in implementing "pollution prevention", particularly in the chemical manufacturing industry. Because of the types of complexities described as examples, pollution prevention not only requires significant advances in production technology, but also vast economic resources in making the needed changes. Again, these considerations limit its global scale applicability at the present time.

POOR AIR QUALITY AND HUMAN HEALTH

In the past there have been disastrous air quality episodes and human mortality (e.g. the London fog, 1952; Bhopal, India, 1984). Such examples have been somewhat rare but not absent in the recent times. Nevertheless, the chronic effects of poor urban air quality on human health continue to be a major issue as our knowledge of the subject grows. Photochemical smog, toxic metals and organic pollutants occupy a central theme. While Los Angeles smog prevails, urban pollution (including smog, particulate matter and lead emissions from mobile sources) has reached critical levels at locations such as Manila in the Philippines. Some 30% of the citizens of Manila are known to suffer from bronchial problems and asthma and blood levels of lead that are disconcertingly high. Recent evidence suggests that PM (particulate matter)–10 (less than 10 μm size) levels above 42 g per m^3 can be related to increased human mortality. Problems similar to Manila most likely occur in other urban centers in the developing nations, but remain inadequately studied. The control of particulate matter from stationary sources, use of catalytic converters and unleaded gasoline in automobiles and efforts to implement effective mass transit systems in the urban centers of developed nations have provided some relief to those locations. Such strategies require stringent environmental laws, economic resources, environmental literacy and societal adaptation. These represent critical limiting factors in their successful application in developing nations at the present time.

GLOBAL CLIMATE CHANGE VERSUS GLOBAL CHANGE

Particularly over the last decade outstanding progress has been made in our understanding of the sources and sinks of chemical constituents in the atmosphere. Although many uncertainties remain, the traditional separatist view of the physical and chemical climatology is rapidly merging. Some atmospheric constituents such as methane have significant contributions from natural sources, while others such as the chlorofluorocarbons are totally a consequence of human activities. Future increases in the concentrations of these and other radiative or greenhouse trace gases are predicted to result in global warming.

Although the issue of how much warming will occur, by when and where is a highly controversial subject, increases in the concentrations of many of the atmospheric chemical constituents alone, their possible role in the destruction of the beneficial stratospheric ozone layer, consequent potential increases in the deleterious ultraviolet–B radiation at the surface, are all factors in "global climate change." In as much as human activity is known to be the major driving factor for the predicted "global climate change", such a change will affect our lifestyles in the future and thus, our impact on climate. Thus, there is a bi-directional feedback between the so–called "global climate change" and the society. Therefore, it is more appropriate to view the overall issue as *"global change"* rather than "global climate change." Future reductions that are needed in population size are a critical component of global change. World food supply and demand will be a critical determinant in that context.

SURPLUS VERSUS DEFICIT FOOD SUPPLY

At the present time in the U.S., there is a surplus of food supply (total area of crops harvested [ha] per capita during 2001, US = 0.48; India = 0.19 and the world = 0.21), although such a supply is not distributed uniformly across all sectors of the population due to political and societal reasons. In contrast, although much progress has been made in agricultural production in developing countries, continued population growth, socio–political conflicts and inefficient or corrupt distribution systems have contributed to a lack of uniform food supply across all sectors in those countries. Thus, starvation is rampant in some parts of the world, as in some African nations. It is expected that the situation will be clearly affected further under global climate change. Continued

increases in the atmospheric concentrations of CO_2 alone will require increased nutrient supply to sustain crop production and quality. For example, under that scenario, phosphate fertilizer is already considered to be a limiting factor in some parts of Africa. Similarly, resource demand as a whole for crop production is expected to increase and this again, most likely will affect food production in developing countries. Elevated atmospheric CO_2 levels coupled with any increases in air temperature and other growth regulating factors is bound to alter the incidence of plant disease and insect pests. We have very little knowledge of these processes. If climatic changes occur slowly, plant breeders most likely can compensate for it. However, as accelerated plant breeding continues, genetic diversity relative to the wild species or type will be progressively compressed, to a point where the magnitude of success may gradually decline (law of diminishing returns). This simply means, certain crops grown in certain geographic areas may have to be replaced by others. For example, the corn-belt in the U.S. being replaced by grain sorghum, possibly due to increased air temperature and limitation of soil moisture.

The overall prediction is that developed nations will have to adjust and increase their food production in the future to compensate for any corresponding decline and increasing demand in the developing countries. In that context, a controversial aspect is the development and deployment of genetically modified organisms that has not gained global acceptance for a variety of reasons.

BIOLOGICAL DIVERSITY

Although over decades ecologists have raised significant concerns about the declines in the populations of certain flora and fauna, air quality and global climate change have provided another dimension to the issue. Dramatic shifts in biological diversity have frequently been a product of direct human intervention (e.g., continued deforestation of the Amazon and the rain forests in Guatemala). Excessive atmospheric inputs of nitrogen (mainly as ammonia (–um) have resulted in the invasion and overgrowth of the Heather moors by tall grass, in the Netherlands. There is also evidence that forest ecosystems in N. America and Europe are suffering from nitrogen saturation due to excess atmospheric deposition, with adverse ecological consequences. Similarly, future increases in atmospheric CO_2 concentrations most likely could result in shifts in competition between C_3 and C_4 plants in mixed communities. Such shifts will alter the composition of native ecosystems and reduce biological diversity (both producers and consumers). In essence some species may disappear completely. Since there are feedbacks between various components in an ecosystem, loss of biodiversity will lead to altered ecosystems. The Endangered Species Act in the U.S. and similar laws in other nations protect flora and fauna against direct human abuse. However, such laws on occasions more often than desirable, lead to conflicts within and between nations when they involve cultural and economic questions or differences in philosophy relative to environmental issues.

ENVIRONMENTAL LITERACY

Environmental literacy requires a unique combination of knowing unbiased scientific facts and using them in a rational manner. Here, a little knowledge can be more dangerous than no knowledge. Although scientists contribute to the knowledge base in a technical sense, the media bring such information to attention for public and political response. Environmental, including air quality, issues frequently stimulate emotions, which can be difficult to separate from scientific facts, because of the rightful public concern for human health and welfare. Here, risk perception and the actual risk can be very difficult to separate. Even when the two phenomena are separated, public acceptance of the facts could fail, if emotions outweigh science. In some societies, industry sponsored research may not receive public acceptance, because of a historical distrust for such information, even if it is correct. Traditionally many profit–driven industries have sponsored defensive or reactive rather than proactive research. That has been one of the reasons for public distrust in such research. There needs to be a concerted effort to develop significant mutually beneficial collaboration among institutions in the public and private sectors.

In contrast, environmental literacy in the developing nations is directly correlated to lifestyles and a basic lack of education. Here, population growth, illiteracy, economics, poor food supply and need for decent shelter outweigh environmental concerns. In addition to the abuse of available natural sources, uncontrolled use of chemicals and poor industrial technology and operation are critical concerns. Although mitigation through political pressure and economic and technology transfer are possible in these cases, adaptation that requires environmental literacy is not expected to totally succeed at the present time in those cases.

A completely different analysis is needed for those countries that have changed from socialistic to democratic governance. Here, the required science is available, at least in theory, but the pressures of economics and the adaptation to market–driven lifestyles are retarding factors. Another limiting aspect is the lack of full knowledge of subtle, but complex air quality issues (e.g., toxic chemicals), since air pollutant emissions have occurred in these countries unabated over decades and their ambient concentrations have not always been monitored in a scientifically defensible fashion.

INTERNATIONAL COOPERATION

International cooperation does not necessarily mean sharing wealth, although some developing countries have used this as a prerequisite for improving environmental conservation. While this may be partly true, global environmental conservation requires sharing of knowledge through education, technology transfer and on site remediation. It is important to note that in general, many developing nations have highly reputable and competent scientists. These individuals simply need opportunities and resources to apply their science and more importantly, peers to communicate with, on the scene. There is nothing better than local solutions to local problems, since these have a better chance of succeeding through local social acceptance. Personally, such experiences have been some of the most rewarding aspects of my career over the last three decades.

There are a number of international agencies striving to deal with global scale

environmental problems. They include: (a) The World Bank; (b) The United Nations Environmental Program; (c) The United Nations Food and Agricultural Organization; (d) The World Health Organization; and (e) various international institutions, such as the Commission of the European Communities, the Rockefeller Foundation, and the U.S. Agency for International Development. There are many other similar organizations.

A disturbing fact, however, is the recent shifts in aid from developing countries to others.

Such changes are driven by short–term socio–political considerations. Nevertheless, in the long–term sharing of knowledge and education are sustainable commodities and that is where academic professionals can have a critical role at the global scale. For example, in as much as the "Peace Corps" in the U.S. and similar programs elsewhere have contributed significantly to humanity across the world over decades, there is a clear need for a similar program(s) of environmental conservation. In this case it would require participation of environmental scientists from many nations and economic support from such nations.

At the present time mitigation or on site remediation is largely in the domain of the private sector in developed nations. Such efforts need to be coupled with improving environmental literacy. An ideal approach to achieving optimal success will require cooperation between the academic community and private sector. There is much room for improvement. In some countries such as Canada, governmental sponsorships of environmental research are greatly improved if academic communities can demonstrate cooperation with the private sector and potential economic or societal benefits to be obtained through technology transfer. We clearly need more of those types of considerations.

THE LIMITATIONS?

Air quality as well as climate change issues are embedded in the conflict between environment and development. Many of the as yet unresolved global problems such as population explosion, underdevelopment, poverty and hunger are currently escalating, a phenomenon also reflected by increasing environmental destruction.

About 80% of global energy–related emissions of radiatively active trace gases is currently caused by 15% of the world population. Energy consumption in the industrialized nations of the North has reached an all time high. The per capita energy consumption in the developing countries is a fraction (between about 1/10 and 1/40) of what is used in the industrialized nations. It is foreseeable in the future, the developing countries (as they follow the industrialization path of the developed nations) will play a much greater role with regard to the change in our air quality and climate. Such impact of the developing countries on the chemical and physical climate would be due to more than just industrialization. The destruction of the environment in these countries (e.g., tropical deforestation and the conversion of deforested areas into farmland) is due to poverty. Furthermore, since there are no other affordable fuels and no working energy supply systems, forests are cut down in order to obtain firewood as a free and essential source of energy. The situation is dramatically aggravated by the population explosion currently observed in these countries. As a result, the environmental resources will increasingly be overused.

Scientific and technological progress in the industrialized nations tends to accentuate economic differences between the rich and poor countries, and it tends to make it more difficult to introduce technological innovations into economically deprived nations. The position of developing countries in world trade is relatively weak. World market prices for their commodities are rather low. Their poverty level continues to increase due to high foreign debt, decreasing foreign investment in the essential sectors within the developing countries, and a substantial net capital outflow from the poor to the rich countries. The gap between the North and much of the South is becoming wider and unless developing countries are given a fair chance to improve their economic status, it will be impossible to stop the destruction of natural resources such as the tropical rain forests.

If air quality and climate are to be preserved, it will be necessary for industrialized nations to reduce their disproportionately high pollution of the environment and for developing countries to overcome their socio–economic problems in an ecologically sustainable manner by achieving their own development, in keeping with their prevalent traditions and the conditions. Many of us forget that local traditions are very critical in our understanding of people at the regional and global scales.

In their justified desire to satisfy the basic needs of their population and to close the prosperity gap between the industrialized nations and the developing countries, the latter have so far mainly been guided by the economic systems of the industrialized nations which have already led to the global over-utilization of resources. Therefore, future international cooperation should consider the described and related limitations in designing environmental programs, and coordinating scientific collaboration and technology transfer.

*The author is grateful to the APS Press for the publication of an earlier version of this article in "Air Pollution, People and Plants: An Introduction" (1997).

Prof. S.V. Krupa is the Professor of Plant Pathology at the University of Minnesota, Twin City Campus, St. Paul, Minnesota, U.S.A. He is Life Member and an Advisor of International Society of Environmental Botanists, Lucknow.

RAPIDC WORKSHOP

Urg Countries (RAPIDC), Programme of Stockholm Environment Institute, a intertnational workshop on "Air Pollution in Asia: Assessing impacts on agricultural and forest productivity" was organised in Bangkok during 9-12 December, 2003.

From India, **Prof. C.K. Varshney** (Jawaharlal Nehru University, New Delhi and Vice President, ISEB) **Dr. H.M. Behl** (Deputy Director, National Botanical Research Institute, Lucknow and Executive Editor Environews), **Prof. Madhoolika Agrawal** (Banaras Hindu University and Member Executive Council, ISEB), **Dr. S.B. Agrawal** (Allahabad Agricultural Institute, Allahabad) and **Dr. Ram Boojh** (Scientist-in-Charge, Centre for Environment Education, Lucknow) attended this Conference and presented their papers.

BIOLOGICAL RECLAMATION OF DEGRADED MINED LAND – A SUSTAINABILITY INDICATOR

SIDDHARTH SINGH

In the mining industry in India, a trend has emerged for the adoption of advance technologies intended for maximum extraction of mineral resources, to fulfill the developmental needs. As a result, they have achieved very high production rate and huge profit margin. The most fitting example is the shift in the technology of coal production from relatively safer underground to highly damaging open cast (surface) mining. Unfortunately, most of the technological enhancement has taken place in production technologies without any concern for ecology and environment. This resulted in severe ecological problems such as loss of our precious prime agriculture land, forest cover, water regime, air quality and biodiversity. With the rising global environmental awareness, the concept of sustainability started gaining popularity. Sustainable development of the Indian mineral and mining industry with ongoing economic reforms is facing enormous challenges and opportunities. Opportunities for investment and hence technological enhancement have opened up in almost all areas including exploration, mining, mineral beneficiation, mining equipment, mineral utilization and environmental protection.

Sustainable development by far remains the most important challenge faced by human society in the 21st century. Development with minimum disturbances to environment without compromising economic growth and quality of life should be our major concern.

MINING AND ECONOMY

Mining industry in India, second largest to agriculture, is one of the largest provider of employment and accounted for about 2.3% of the total GDP i.e. Rs. 45,230 crores in the year 2000-2001. We produce 64 minerals and the distribution value of mineral production in the year 2000-2001 shows that fuel accounts for about 83% (solid fuels 37% and liquid/ gaseous 46%), metallic minerals about 7%, non-metallic minerals about 3% and remaining by minor minerals. Coal remains the primary source of energy, accounting for about 80% of total energy generation in the country. About 310 million tonnes of coal was produced in the year 2000-2001 and it ranked third in the global market. In the coal sector, all that is achieved must be credited to the nationalization of coal companies in 1971-72. Post-nationalization era has witnessed a sea change in mining technology as well as scale of operation. Relatively clean, underground mines occupied more than 70% share of coal extraction before nationalization. Gradually, more and more open cast mines were opened to balance the demand/ supply ratio and at present, they dominate with 80% share. India is a major exporter and holds globally a very strong position in the production of chromite, kyanite, illimanite, iron ore, bauxite and manganese ore.

MINING AND LAND DEGRADATION

Land degradation is considered as an unavoidable by-product of mining and can be widely defined as a human induced or natural process that negatively affects the land to function effectively. UNEP (1992) describes it in a simplified definition as "the temporary or permanent lowering of the productive capacity of land".

Nature has endowed us with a variety of mineral resources. The matter becomes sensitive as most of the mine sites traversing from the height of Himalayas to the sea shore of eastern and western ghats and peninsular India fall in the ecologically fragile and biodiversity rich area. Land degradation due to mining has reached alarming proportions mainly due to over exploitation and mismanagement of natural resources. One of the consequences of ever increasing human population, supported by accelerated land degradation is lowering of the man – land ratio. Our per capita land availability has been reduced to 0.328 ha.

Mining and industrial waste has been estimated to degrade 0.04% of total geographical area of the country. Mining complexes as estimated recently occupy around 36-lakh hectare of land, which is 0.11% of total land area of the country. Ministry of Agriculture, Government of India has estimated that the proportion of land degraded due to mining and industrial waste was about 2.53 lakh ha in 1994. Although the figure is not very significant, its enormity can be understood by the fact that the total degraded land is 55% of the geographical area of the country.

MINING AND SUSTAINABLE DEVELOPMENT

With the publication of The World Commission on Environment and Development's report *One Common Future* in 1987 also known as Brundtland Report the concept of sustainable development came into the prominence. There was a big question mark on extracting industries (Mineral, Petroleum and coal) for sustainable development since long. Almost all the mining techniques from mineral explorations to production and transport are causing environmental damage in several ways. The list includes deforestation, loss of top soil, accelerated soil erosion, soil contamination, qualitative and quantitative depletion of surface and ground water resources, migration of wild life and avian fauna, and addition of air pollutants and dust in the atmosphere. Several of these constraints are exceptionally difficult to avoid in surface mining. Thus, it sounds unconvincing to achieve sustainability in mining processes. A lot of debate and very little agreement has taken place for the sustainable status of extracting industries.

Sustainable development is widely defined as "development that meets the needs of the current generation without compromising the ability of future generation to meet their own needs". It has been further elaborated in 1991 by Ecologically Sustainable Development Working Group on Mining as "ensuring that the mineral raw material's need of society are met, without compromising the ability either of future societies to meet their needs, or of natural environment to sustain indefinitely the quality of environmental

services such as climate systems, biological diversity and ecological integrity". Such sustainable development conserves the resources like land, water and biodiversity. Sustainable systems are less risky, environmentally non-degrading, technically apt, economically feasible and socially acceptable.

The World Summit on Sustainable Development at Johannesburg 2002 has defined the role of stakeholders in sustainable development and rights and responsibilities in development processes. Thus, one can infer that mining under appropriate environmental guidelines, can only be sustainable through participatory process of assessment and commitment involving governments, industry, non governmental organizations, community and individual stakeholders in the decision making process, directed towards optimizing economic development while minimizing environmental degradation.

BILOGICAL RECLAMATION AS A SUSTAINABILITY INDICATOR

Many of the social issues responsible for the outcry can be subsided by providing the source of livelihood to the affected inhabitants. Biological reclamation of the degraded land with predetermined end use has the potential to fulfill it. In the majority of cases, reclamation of abandoned mineral workings requires the establishment and maintenance of vegetation on disturbed land. No other medium can achieve rapid visual integration, surface stabilization, or reduction in air and water pollution, nor offer a wide variety of land-use possibilities, which can be achieved at acceptable cost. Based on several ecosystem restoration studies, A. D. Bradshaw, the pioneer restoration ecologist, concluded that vegetation is the most appropriate and cost effective long-term remedy to encounter the majority of underlying problems of derelict-mined land.

Revegetation of mined out areas is often difficult due to its chemical and physical traits. Absence of topsoil is the most common feature of the mine spoils or dumps. If present, it is very poor in nitrogen, which isessential for plant growth. This is due to the absence of soil organic matter provided by decay of dead plant material. Moreover, dearth of soil micro flora restricts the decay of plant material. In addition, the stony nature of mine wastes aggravates the situation further for vegetation establishment by developing *low infiltration rates* and *water retention.* Since the progress of natural vegetation process is very slow on mine spoils, selective plantation of suitable native species is desired in most cases.

In common practice, mining engineers, always unguided by any ecological principle prefer to establish some greenery on wasteland. However, the development of a permanent vegetation cover should aim to establish a plant community that will maintain itself indefinitely without attention or artificial aid, and support native fauna. To extract better results, some ecological variables must be considered while selecting species for plantation. These are; their capacity to stabilize soil, increases soil organic matter and available soil nutrients, and facilitate under storey development. In the initial stages of revegetation quick growing grasses with short life cycle, legumes and forage crops are recommended. It will improve the nutrient and organic matter content in soil. Plantation of mixed species of economic importance should be done after 2-3 years of growing grasses.

The biological reclamation in its lowest magnitude intends to put the degraded land to some use to the stakeholders. On the other hand, it may be designed to accomplish the ecologically challenging task of reestablishing the previously existing ecosystem, going species by species. Now the question arises about the criteria of sustainability indicator and whether biological reclamation fulfills it?

It is impossible to replenish the minerals once mined out, however; we can reclaim the derelict land by establishing self-sustaining vegetation cover with pre-determined end use. A successful biological reclamation restores the natural capital of flora and fauna and productivity of land, which had been previously converted into fabricated capital through mining. This feed back mechanism very strongly advocates the suitability of biological reclamation as an indicator of sustainability and sustainable development of mining industry.

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INTEGRATING ENVIRONMENT EDUCATION IN TECHNICAL &VOCATIONAL EDUCATION IN ASIA

NEELIMA JERATH

Graduates of Secondary Technical & Vocational Education (TVE) Schools enter into trades that have a direct impact on the environment. Hence, they can play a crucial role in implementing practical solutions to current environmental problems and promote sustainable development through application of appropriate technical solutions. Recognizing this, UNESCO organized the Second International Conference on Technical & Vocational Education in 1999 at Seoul, wherein the need for promoting Environment Education (EE) in TVE systems was highlighted. As a sequel to this, UNESCO has initiated a project on 'Integrating Environment Education in Technical and Vocational Education' in Asia, Africa and Latin America. The main objective of this project is to gain an overview of initiatives taken up by various countries on Integrating Environment and Sustainable Development Education in Technical and Vocational Schools to identify gaps and future needs. The first phase of the project has been taken up in Asia, with the Punjab State Council for Science & Technology as the Asian partner. The project has been taken up in 5 Asian countries i.e. China, India, Indonesia, Malaysia and Philippines with the help of some specially identified institutions in each country.

Dr. Neelima Jerath, Joint Director – Environment, Punjab State Council for Science & Technology, and a Life member of ISEB visited various centers for discussions on the project. She analyzed the country reports to prepare the Asia report, which highlights general concerns for EE in TVE in important countries of the continent.

As a follow up of the project, an International Workshop was organized at Chandigarh from 3rd to 5th September 2003. It was attended by experts from UNESCO, country Nodal Officers from China, India, Indonesia, Philippines and Malaysia and Subject experts from French Ministry of Agriculture; CPSC, Manila; GTZ, New Delhi, CEE, India; CIVE, India and TTTI, Chandigarh. The workshop helped to learn the experiences of participants and experts on existing policies and projects in the area, and develop a plan of action for follow up activities at the national, regional and international levels.

***Dr. Neelima Jerath**, is the Joint Director (Env), Punjab State Council for Science & Technology, Sector 26, Chandigarh-160019, India.*

NEWS AND VIEWS

BIO-FERTILIZERS: BOON FOR FARMERS

A great majority of Indian farmers, who are very poor, cannot afford chemical fertilizers to improve the soil fertility and increased yield of crops. Besides, chemical fertilizers have an adverse effect on the environment. Bio-fertilizers on the other hand are eco-friendly, efficient and required in much less quantities.

Most plants need nitrogenous compounds such as nitrate or ammonium. Fertilizer manufacturing factories fix nitrogen by a cumbersome process needing lot of energy. The chemical fertilizers are therefore, quite costly. On the other hand biological nitrogen fixation, that is, nitrogen into ammonia by the nitrogen fixing microbes and blue green algae is much cheaper and eco-friendly.

The bacteria convert the atmospheric nitrogen as nitrate in the soil and the plants consume these nitrates. Microbial biosphere adds about 275 million tons of nitrogen to soil annually through biological fixation, that is much more than the quantity produced industrially. Besides nitrogen, phosphorus is another major element for growth of flowers, fruits and grains. Phospho-bacteria convert the insoluble phosphates to soluble ones and help consumption by the plants.

Knowledge of these processes paved the way for development of Bio-fertilizers. Considering the immense potential of Bio-fertilizers and their eco-friendly nature the day is not far when even the poorest of poor Indian farmer will be able to use them in his fields.

V.K. Joshi , *in Hindustan Times*

GLOBAL WARMING AND FLOOD OF REFUGEES

The number of people seeking refuge as a result of environmental disaster is set to increase dramatically over the coming years. Global warming – more than war or political upheaval – stands to displace millions. And climate change is being driven by our fossil fuel – intensive life styles.

Environmental refugees are already with us, though they have no official status. They are people who have been forced to flee their homes because of factors such as extreme weather, drought and desertification. In 2001, 170 million people were affected by disasters, 97% of which were climate-related, such as floods, droughts and storms. In the previous decade more than 100 million suffered drought and famine in Africa, a figure likely to increase with global warming. Many times more were affected by flood in Asia.

Andrew Simms,
Source: *Environment Nepal.*

STROKES GO UP AS AIR QUALITY DROPS

People are more likely to be hospitalized for strokes on days when air pollution is bad, according to a study carried out by the Kaohsiung Medical University in Taiwan. Strokes occur when blood is unable to reach areas of the brain usually because of a blocked or damaged blood vessel. This study provides new evidence that higher levels of ambient pollutants increase the risk of hospital admissions for stroke, especially on warm days. The findings are based on a study of stroke and air pollution data recorded in Kaohsiung between 1997 and 2000. On warmer days, stroke admission rates increased as air levels of particulate matter, nitrogen dioxide, carbon monoxide and other pollutants rose. In contrast, on cooler days, only carbon monoxide levels were tied to such rates. Particulate matter and nitrogen dioxide seem to be the most important pollutants.

For each incremental rise in air levels of particulate matter and nitrogen dioxide, the risk of stroke admission rose by around 50 percent. These findings support the possibility that there are disease processes in the blood vessels supplying the brain that are triggered by air pollution.

Reuters, *(Acid Rain)*

BLACK CARBON EMISSIONS HAVE CLIMATE CHANGE EFFECTS

Black carbon soot from coal burning, diesel engines, open fires, and other sources is contributing to global warming and climate change in China and India. Black carbon — a product of incomplete combustion — comes from industrial pollution, traffic, fires, the burning of coal in homes, and biomass fuels. It is especially prevalent in countries such as China and India, where cooking and heating are typically done at a low temperature using wood, cow dung, or coal.

Unlike carbon dioxide emissions, which add to global warming by trapping heat in the atmosphere, soot emissions may contribute to global warming and climate change by absorbing sunlight, heating the air, and making the atmosphere more unstable, according to the study.

Research into black carbon is a relatively new area, global climate change experts say. Some of the uncertainties include exactly how particles behave in sunlight and how much of the soot comes from any particular burning process.

However, the study shows that there are very strong reasons for China and India to take action to reduce soot emissions from cook stoves, coal-burning furnaces. Doing so would moderate both the local health effects and the regional climate effects from those emissions.

Associated Press.

12,000 SPECIES THREATENED

According to IUCN, 762 plants and animals have vanished since AD 1500 and another 58 are known only in cultivation or captivity. Another 2,000 species have been added to the annual Red List of the world's most endangered animals and plants. The catalogue produced by IUCN – The World Conservation Union, now includes more than 12,000 entries.

Wildlife is being lost through the effects of invasive alien species, which have driven to extinction four plants from

Ascension Island that were found nowhere else. Several Atlantic islands face unrelenting pressure from invaders, grazing animals, and habitat loss. The Red List says the future of Hawaii's plant life looks grim because of invasions, loss of pollinators that evolved with native plants, and human pressures. Of Hawaii's 125 endemic plants added to the Red List this year, 85 are threatened.

The oldest seed plants on Earth, cycads are among the most threatened plants. The wild population of the St. Helena boxwood currently numbers just 16 individuals. Seaweeds and lichens feature on the list for the first time. Among the countries with the highest numbers of threatened birds and animals are India, Indonesia, Brazil, China and Peru. Plants are declining fast in Ecuador, Malaysia, Indonesia, Brazil and Sri Lanka. Human activities may be the main threat to the world's species, but humans can also help them recover – the white rhino, Arabian Oryx and Chinese Crested ibis are just a few examples.

Alex Kirby
(BBC News online environment correspondent)

E-WASTE

A recent study in the U.S. shows that in 2004, over 315 million computers will become obsolete. California alone discards 6000 computers daily. In Europe the volume of e-waste is increasing by 3.5 per cent per annum, almost three times faster than the growth of municipal solid waste.

About 70% of heavy metals found in landfills come from electronic discards, which contaminate the groundwater. E-waste is also incinerated leading to hazardous emissions. For instance, copper commonly found in e-waste acts as a catalyst for dioxin formation.

The chief means of managing e-waste is export to poor nations for recycling because the labour cost there is low, and environmental and occupational regulations weak.

Nidhi Jamwal
(Environment Nepal)

SOOT PARTICLES CAUSE HEALTH HAZARDS

A draft report prepared by the Environmental Protection Agency, U.S.A. says that rules adopted in 1997 do not adequately protect the elderly and people with respiratory problems and should be tightened. The findings could become the basis for additional Pollution Control requirements to reduce the amount of microscopic soot emitted by diesel burning trucks, cars, factories and power plants.

The draft paper says that since 1997, some scientific studies have confirmed the association between exposure to microscopic soot and premature deaths, cardiovascular problems and respiratory illnesses. Such soot contains particles 20 times smaller than a strand of human hair. The annual and 24-hour average permissible under the 1997 rule is 15 and 65 micrograms of soot per cubic meter of air respectively. The staff analysis recommends that the annual average might have to be cut to 12 micrograms and 24-hour standard to between 30 and 50 micrograms of soot per cubic meter of air to achieve adequate health benefits. Health advocates agree that tougher air quality standards are needed for microscopic soot because it can become easily lodged deep inside the lung tissue.

Recent researches have shown that even short-term exposure to particulate pollution can be dangerous for some people, particularly the elderly, young children and people with asthma and other serious lung diseases.

CBS/AP

CHINA PUTS CORN INTO GAS TANKS

Jilin Province, in the northeast of China, home to China's first car factory and also its biggest corn producer, is putting corn and cars together in a project to ease the country's exploding pollution. It is using its huge farm surplus to make organic fuel that cuts pollution and reduces dependency on petroleum imports at the same time. China, which is the World's fastest growing car and energy market could extend the use of ethanol gasoline throughout the country by 2005 if initial exploratory steps are successful.

Fuel ethanol cuts greenhouse gas emissions. From October 2003 all car, truck and bus drivers in the province are required to blend into their gasoline 10% of the biofuel distilled from corn. It can be produced also from wheat, sugar, rapeseed, palm oil, cassava or even recycled food oil, such as old frying oil collected from fast food restaurants.

It takes about three tonnes of corn to produce one ton of ethanol. Ethanol is estimated to cost US $ 484 per tonne compared to gasoline, which will cost US $ 327 a tonne. Jilin Fuel Ethanol, a joint venture is to convert 900,000 tonnes of corn into 300,000 tonnes of fuel ethanol each year.

Over the past decade, China accumulated massive grain stocks because of its policy of 'food security' but now the emphasis has shifted to 'fuel security' and environmental protection.

Nao Nakanishi

METHANE LEVELS STABILIZE

Atmospheric levels of methane, the second most significant greenhouse gas after carbon dioxide, have stabilized after 200 years of growth, according to the results of studies carried out by American and Dutch researchers who found a sustained plateau in methane concentration between 1999 and 2002. Research by Australian scientists at Commonwealth Scientific and Industrial Research organization showed similar results, with methane showing no rise over the past four years. The findings compare with a 15 per cent increase since pre-industrial times.

Methane presents an opportunity for a global warming success story. We could get it to stop increasing and even decrease somewhat, mostly with actions that make sense for other reasons.

Methane is 23 times more potent than carbon dioxide and is responsible for a fifth of the greenhouse effect over the past 200 years. What caused the leveling off in methane remains largely unknown, although some measurements taken by the American and Dutch teams would seem to credit a downturn in Russian emissions in the early 1990s.

Methane is linked to human activities such as agricultural production, mining and the use of fossil fuels. Among greenhouse gases it is easiest to control methane.

Clean Energy Nepal
(Source: AFP/Johannesburg Independent Online)

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The Fifth China International Garden and Flower Expo
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