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*With you in Pursuit of Sustainable
Management of Finite Water Resources*

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Point for discussion this month **Self-regulation of ecosystem processes**

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Eternal Words

We have to shift our emphasis from economic efficiency and materialism towards a sustainable quality of life and to healing of our society, of our people and our ecological systems.

~Janet Holmes à Court

Waste not the smallest thing created, for grains of sand make mountains, and atomies infinity.

~E. Knight

Dear Readers,

Pollution does not recognise geographical boundaries, nationalities and economic status. Creation of superbugs might be irrespective of water bodies in vicinity of poor communities or hi-tech settlements. Wastes are dumped and water bodies are defiled mostly by affluent people who display and express the disrespect towards environmental resources. These wastes change the physicochemical-biological properties of receiving water bodies to such an extent only harmful species thrive on that. These phenotypical adaptations get transferred to genotype when generations of microorganisms are exposed to changed environmental conditions.

As visionary Dr. Mohan Kodarkar, a great ecologist of India used to say that most of the issues of water bodies could be sorted out by ecosystem approach with committed technico-legal management of governance. In this issue, many aspects of superbug's problems have been discussed with probable solutions and approaches. A high-powered committee comprised of environmental experts shall be formed at national and international levels to establish relativity between discharges of wastes, severity of water pollution and germination of superbugs and to provide solutions to ecological health and in turn human health problems.

In last month's issue (April 2011), article on radioactivity in Japan due to tsunami as a result of earthquake was published. Dr, Saburo Matsui Emeritus Professor of Kyoto University of Japan agreed to the severity of the radioactive effects and expressed desire to find the solutions for these problems. In this issue, we included his concern with response from our Ecotechnologist, Sandeep Joshi.

All of us as a one humanity has delve in maintaining the life on this earth. The serene water body (beautiful spot in Western Ghats of Kerala state of India) in the cover photo demands the concerted efforts of all stakeholders including governance by keeping aside economic and market aspirations, stiffness on geographic boundaries, social and personal enmities for the sustainable development without loosing the ecological health.

Thank you,
Chief Editor

Superbugs: A Cause to Worry

- Sandeep Joshi
Environment Technologist

Billions are put in to eradicate draconian diseases from the earth from last few centuries to make human life disease free. But, regardless of technological advances, brutality of infectiousness of pathogens is not sinking at all! Rather, bugs are becoming superbugs! So, super drugs are to be invented to protect humans from wrath of superbugs.

In 2000, Dr. Wetherbee, infectious disease expert of New York University's Tisch Hospital noticed a multi-drug resistant bug named *Klebsiella pneumoniae* isolated from a patient in intensive care unit. It inhabits both humans and animals. It can survive in water. It is found on human skin, in nose and throat. It is most common in stool. It can adhere to the lining of the throat, trachea, and bronchi.

Attached microbes can travel deep into lungs, and destroy the delicate alveoli. Resulting hemorrhage produces a blood-filled sputum - "currant jelly." *Klebsiella* can also attach to the urinary tract and infect the kidneys. When it enters the bloodstream, it releases endotoxin injuring the lining of blood vessels and can cause fatal shock.

There are many such drug-resistant bacteria found over a period of time like methicillin-resistant *Staphylococcus aureus*, or MRSA. In a recent study it is found that some of the U.S. meat supply is contaminated with drug-resistant staph bacteria. In 2005, there were about 11,400 deaths related to *Staphylococcus aureus* infection, of which about 6,600 were MRSA-related according to a 2007 study published in *Emerging Infectious Diseases*.

Historical investigations may lead to the findings of extensive use of antibiotic and unscrupulous throwing habits of modern world. It is not only antibiotics but dumping of millions of tons of other chemicals like solvents, pesticides and fertilizers into the environment at billions of hazardous chemicals disposal sites across the world also might be responsible for unprecedented changes in the genetic materials of the bacteria.

Cardiff University's Mark Toleman with Timothy Walsh carried out studies on NDM - 1 in September and October 2010 in Delhi. The results were published in *The Lancet Infectious Diseases* journal. It revealed shocking occurrence of NDM 1-producing bacteria in community waste seepage (such as water pools or rivulets in streets) and tap water in urban New Delhi.

The NDM - 1 gene creating 'super superbugs', has spread among the germs that cause cholera and dysentery. It is circulating freely in other bacteria in the Indian Capital with population of 14 million, researchers speculated. NDM 1 (or New Delhi metallo-beta-lactamase) strengthens bacterial resistant to almost all antibiotics, including most powerful class carbapenems. As per the conjecture of those scientists, the gene first emerged in India three years ago. Now it is spreading across the world. It has been found in a wide variety of bugs, including familiar opportunistic pathogens like *Escherichia coli*.

Those researchers collected 171 swabs from seepage water and 50 public tap water samples from locations within a 12 km radius of New Delhi during September and October 2010. The NDM 1 gene was found in 2 of the drinking-water samples and 51 of seepage samples, and bacteria positive for NDM 1 were grown from two drinking-water samples and 12 seepage samples.

These findings (may not be associated with certain city) need to be verified carefully by the scientists of world in their own cities (New Delhi or India does not matter for that matter - it's a phenomenon which is important) where there might be such thousands of genes developing at waste dumping sites. There are billions of such sites across the world. This alludes to develop a better worldwide sanitation and waste management programmes for control of superbugs and for sustained ecological health of the drinking water sources.

It is also utmost essential to have better waste treatment and disposal practices for wastes being discharged into the environment by pharmaceutical manufacturers. The issue should not be restricted to only occurrence of NDM - 1 like genes, its monitoring and eradication using powerful (?) drugs but to be looked from the entirety of environmental, technological, social, and economical political, and market aspects also.

In 2008, it was reported that trace concentrations of pharmaceuticals had been found in drinking water provided to at least 46 million Americans. But the wastewater downstream from some Indian pharmaceutical plants contained 150 times the highest levels detected in the US. So, there might be such innumerable sites which are receiving their own dose of thousands of deadly chemicals every day.

Therefore, there is urgent need to form a world task group to identify cradles of super-superbugs creating genes. For example, Patancheru, near Hyderabad became a hub for chemical and drug factories since 1980s, creating copious amounts of liquid and solid wastes. Researchers analyzed samples of treated wastewater from a plant where about 90 drug factories dump their residues. It

was found that powerful antibiotics were being spewed into one stream each day sufficient to treat population size of 90,000.

As per the observations of curious citizens and NGOs, at the Patancheru's wastewater treatment plant, operations and processes involved transportation of wastewater from the 90 bulk drug makers by tankers to the plant and poured into a cistern, filtration of solids, then mixing with raw sewage to biologically break down the chemicals. After that the partially treated wastewater, which has been clarified but is still contaminated, is discharged into the Iska Vagu stream that runs into the Nakkavagu and Manjira, and eventually into the Godavari.

The gamut of superbug is unfathomable with current epidemiological practices and procedures, but the attempt is being made to make it politico-economic health issue, so that the interests of the parties to be served amicably. Instead of allowing taking it undesirable shape, it is necessary to look at it from the point of human survival on the earth. A minutest biological molecule - gene is unfolding the charter of new arena of dreaded disease causing agents which do not respond to strongest chemicals.

Is it natural mutation in response to changing environmental conditions due to improper waste disposal? Is it due to unplanned growth of urban areas? Is this an unprecedented threat only in developing or underdeveloped areas or is it rampant in developed, most modernized areas also? Are these issues of medical fraternity or water engineering? Or are these much beyond their ambit of knowledge? What is the solution then? Who can be angel for saving the humanity from superbug issues?

Will waste management with ecological approach help in this matter? After all, it's a natural selection process as stated by Darwin century ago. Species are selected based on their adaptability to changing conditions. If human beings want to survive on this earth for millions of years then current political, economic and market policies need reforms and a new order may be required to cope with the upcoming problems.

These reforms need just utilization of natural resources without damaging the integrity and quality of resource reservoir. These reforms need ecological cycling of waste generated from human activities without disturbing the material and energy cycles in time and space. If this becomes the basis for livelihood, then all exploitative economic and market principles, political imbroglios, competitions will take back seat. Then "superbug" will not be so frightening issue.

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Response to SERI news, April, 2011

Dear SERI editors

Thank you for your special issue of the earthquake, tsunami followed by nuclear plant accidents, March 11, 2011 in East Japan. Your news describes the enormous tragedy of natural and manmade disasters. The tragedy is still going with thousands of survivors who lost family members as well as their properties.

The debris and nuclear waste are big problems among many problems. It will take three years to stabilize the problem of debris according to our experience of Hanshin-Awaji earthquake in 1995, but more time necessary for nuclear waste. Some of the nuclear species have a half decay time more than 80 years, Japan experienced atomic bombs in Hiroshima and Nagasaki that were the first and second tragedies of atomic warfare. Japan experienced Fukushima nuclear plant failure. These historical events symbolize the failure of humankind in terms of nuclear technology that must not be a playing toy anymore. Stop the nuclear games both in atomic bomb production and atomic power supply. No more Hiroshima and Fukushima!!

Japan developed many high technology industries that have been supported by developed education systems in engineering. As a professor of engineering faculty in Kyoto University one of the prestigious universities in Japan, I observed for twenty years how the atomic reactor and relating engineering developed in terms of research activities. One third of national research fund was spent in the nuclear power engineering. It got an enough research fund for more than twenty years in Japan. As a professor of environmental engineering that was a relatively new area in research fields, I faced always difficulty in obtaining a research fund, because industrial pollution and environmental destruction are not happy issues to industry people and politicians in the past. Nowadays, every person in industry speaks about environment and ecology in a manor of a fashion,

In spite of such a favored condition provided for nuclear power engineering, the accident this time hit by earthquake and tsunami revealed that there many weak points remained against Nature activities. Even nuclear power plants run well, they produce a high level condensed nuclear waste that must be kept untouched by 100,000 years for complete stabilization in somewhere? Japan has not yet determined a safe place for storing them in 100,000 years. Do not play nuclear power games in both atomic bomb and power plant. India

has been involved in the game of the atomic bomb. I would like to comment your optimistic approach of decontaminating nuclear polluted soil by planting flowers that absorb Cs and Sr, etc. You should consider how to collect and treat those plants and flowers after absorbing the species. How do you dispose them that are enriched in the nuclear species.

The business of plant remediation is not easy for nuclear species. Thank you

Dr, Saburo Matsui

Emeritus Professor of Kyoto University

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Dear Dr. Matsui,

Thank you for letter and observations. We agree that plant remediation is not easy for nuclear species as this concept has not been explored yet. Though today's modern man has achieved a lot by exploiting natural resources to satiate the needs of food, water, and energy but he has to learn a lot to cope with accumulating waste.

Human species is comparatively much younger than other biological species including microbes, plants and animals. They have accumulated the intelligence of survival in extremities of environmental conditions from thousand millions of years. It is there in their genes. We humans can take help of that to protect us from the extreme conditions. Only thing is that we should know which species is useful in which conditions.

Inhabitation of waste dumping by microbes and vegetative species definitely attract feeders - micro-invertebrates and then the ecological food chain goes on. Ecological documentation of Chernobyl accident will provide loads of information about adaptation of ecological communities to harsh conditions over a period of time.

Then human intelligence is required to compile and process this information with lab-scale, pilot-scale and field scale experimentations and their outcomes to arrive at certain strategic steps to absorb the shocks of explosions or accidental releases of radioactivity. This will alleviate the fear of nuclear power which is being branded as cleanest source energy as far as climate change is concerned. We at SERI will be happy to help in developing these concepts for the people of Japan! Best of wishes!

- Sandeep Joshi, Environment Technologist

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