

Training Program

Future Perspective of Environmental Biotechnology

Prepared for

Central Pollution Control Board, New Delhi



December 2018

The Energy & Resources Institute

Training program team

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Contents

Importance of the Training program	4
Course Content of the Module.....	2
Detail of Faculties in the Training Program.....	3
Program Schedule of the Training Program	5
List of Participants in the Training Program	7
Detail of the Training Program	9
Conclusion	19
Photo Gallery	20
Annexure: I – Approved List of Participants	
Annexure: II – Daily Registration Sheets	
Annexure: III – Feedback of Participants	

Importance of the Training program

One of the greatest problems that the world is facing today is that of environmental pollution, increasing with every passing year and causing grave and irreparable damage to the earth. Environmental pollution has existed for centuries but only started to be significant following the industrial revolution in the 19th century. Pollution occurs when the natural environment cannot destroy an element without creating harm or damage to itself. The elements involved are not produced by nature, and the destroying process can vary from a few days to thousands of years (that is, for instance, the case for radioactive pollutants). In other words, pollution takes place when nature does not know how to decompose an element that has been brought to it in an unnatural way. Environmental pollution consists of five basic types of pollution, namely, air, water, soil, noise and light.

Environmental Biotechnology is a rapidly developing, increasingly important branch of science that has implications for both the prevention and clean-up of pollution in different strata of the environment. One notable example is bioremediation, i.e., the use of microorganisms to clean up contaminated environments, including contaminated soils, sediments and water. Environmental biotechnology is at the interface of biology and engineering, which presents both significant opportunities and limitations. Effective application of environmental biotechnology requires professionals who have a background in both areas.

However, environmental engineers have considerable engineering skills required for the design of processes *per se*, have only a rudimentary knowledge of general biology and microbiology in particular. The development of a training program on Environmental Biotechnology satisfies an urgent need in terms of professional preparation, and is timely as biology and engineering are becoming more integrated to solve our future problems related to environment.

There are opportunities in Environmental Biotechnology to provide sustainable solutions to diverse environmental problems. The Pollution Control Boards in India was established to control the environmental pollutions particularly in water and air. However, at present, Pollution Control Boards across the nation working on industrial waste management, municipal waste management etc. apart from controlling the pollution of the air and water.

This training program was designed with the objective to develop the understanding on the application of molecular biology and biotechnology to solve environmental problems as noted in diverse areas across the country. Additionally, this short duration training program was also supported the participants to develop professional networks which would help them to develop future plans to crack environmental pollution problems with sustainable application of biotechnology.

Course Content of the Module

Module No.	Theme of the Module
1	Basics of Molecular Biology and Environmental Biotechnology
2	Environmental Biotechnology- Role and implication in environmental remediation <ul style="list-style-type: none">• Importance of biotechnology in environment protection• Role of biotechnology in safeguarding of ecosystem- air, water, soil
3	Bioremediation and nanotechnology application in waste water treatment <ul style="list-style-type: none">• Remediation of industrial dye• Treatment of pharmaceutical drugs• Nanobiocomposites
4	Bioremediation of organic pollutants <ul style="list-style-type: none">• Microbial activity in pesticide degradation• Treatment of oil spills
5	Management of solid waste by Rapid composting technology <ul style="list-style-type: none">• Vermicomposting application in waste management• Development of low cost technology for waste decomposition
6	Biotechnology application in waste to energy production <ul style="list-style-type: none">• Bioremediation and treatment of waste• Bioenergy production and utilization
7	Policies in Biotechnology in India <ul style="list-style-type: none">• Scopes in developing projects on environmental biotechnology• Role of other Government departments

Detail of Faculties in the Training Program

	<p>Prof. Satyabathi Sharma is Professor at Centre for Rural Development and Technology, Indian Institute of Technology Delhi. Her research interests lies in Bio-inoculants and Bio-fertilizer, Rapid composting/Waste management, Tissue culture, Fungal and botanical bio-pesticides, Wasteland Reclamation, Mushroom technology, Vermitechnology, Silvipastoral technology and Biogas slurry management. She has received the 'Iraj Zandi award' in 2013 in recognition of her contribution to the field of Solid Waste Technology and Management by Widener University, Philadelphia, USA. Email: satyawatis@hotmail.com</p>
	<p>Dr. Vibha Dhawan is one of the Senior Directors in TERI and Fellow of National Academy of Sciences, India. She has also completed one term as Vice-Chancellor, TERI-School of Advanced Studies. Dr Dhawan is actively involved in research as well as policy development, both at the national and international level She was an Advisor, Bio-resources & Biotechnology to the former Chief Minister of Assam (2007–2016). Her major achievements includes developing e-contents for PG programme in Biotechnology, an initiative of University Grants Commission, establishing Micropropagation Technology Park and Biofuel research at TERI with support from DBT, India. Email: vibhad@teri.res.in</p>
	<p>Dr. Banwari Lal is one of the senior directors in TERI. He is an eminent biotechnologist of the country. He is a member of the Scientific Panel of the Food Safety and Standards Authority of India, Ministry of Health & Family Welfare His area of interest is Petroleum Biotechnology and has developed three technologies namely "Oilzapper ", "Microbial Enhanced Oil Recovery" and "Prevention of paraffin deposition in oil well tubing and flow lines". He is the founding director of the ONGC-TERI Biotech Ltd. which is a start-up company. All the three technologies are patented and commercialized. Email: banwari@teri.res.in</p>
	<p>Dr. Punarbasu Chaudhury is an Environmental Microbiologist and Associate Professor at the Department of Environmental Science, University of Calcutta, West Bengal. Dr. Chaudhuri did his post doctoral research on the effects of costal pollution on mangroves from University of Sydney as Endeavour Fellow of Government of Australia. He participated Canadian Sub-Arctic expedition as Shastri Indo-Candian fellow to study the impact of climate change on polar environment. He received Young Investigator Fund from Department of Science and Technology, Govt of India for Climate change studies in Hooghly estuary. He has more than fifty research publication in different international journals. Email: punarbasu_c@yahoo.com</p>
	<p>Dr. Nupur Bahadur is Fellow at TERI and adjunct faculty at TERI School of Advanced Studies, New Delhi. She envisions to contribute in Nation building through teaching, research, innovation, development & dissemination of Science & Technology towards providing solution to Environment and Wastewater related challenges. She is the Vice Chair of International Water Association, India Chapter. She has four registered Patents towards her technology and bagged First Prize at the forum 'Design & Manufacturing Technologies for 'Make in India' as part of IISF-2015, Ministry of Science & Technology, Govt. of India. Email: nupur.bahadur@teri.res.in</p>
	<p>Dr. Sutapa Dutta is Plant Biotechnologist, from the ICAR-National Research Centre on Plant Biotechnology, New Delhi. She was a Post-doc and demonstrator in different courses of molecular biology at the University of Aberdeen, United Kingdom. She works in the development of molecular markers for climate resilient crop improvement. She has publications in different international scientific journals. Email: koyeldatta@gmail.com</p>

	<p>Dr. Md. Azizur Rahman is working as post-doctoral fellow at department of Chemical Engineering, Jadavpur University, Kolkata with National Post-Doctoral Fellowship (NPDF), awarded by SERB-DST, India. He was awarded Doctor of Philosophy in Engineering from Indian Institute of Technology Delhi. He has research and constancy experience in the field of resource recovery from waste streams, faecal sludge management, sanitation, appropriate technology for rural development and nanotechnology. Email: azizur.md.rahman@gamil.com</p>
	<p>Dr. K. Dheeban Chakravorthi is Fellow at TERI. He is in algal biofuel research. His focus areas are photobioreactor design, algal harvesting and lipid recovery. He has previously been a Senior Research Engineer at the algal biofuel company, OriginOil in Los Angeles, USA. He has publications on algal growth system design, algal nutrient uptake, lipid recovery, engineering aspects of algal biofuels and phase equilibria and patent applications on outdoor algal growth system and wet algal lipid recovery. Email: dheeban.kannan@teri.res.in</p>
	<p>Dr. Sanjukta Subudhi is a molecular microbiologist and working as senior fellow at TERI. Her major research achievements include development of pilot scale microbial process for bio-hydrogen production. Research explorations of her group span the domain of; (i) microbial production of clean fuel, (ii) cyanobacterial based PUFA production, (iii) use of microbes/algae for production of value added chemicals and enzymes, biopolymers. Email: ssubudhi@teri.res.in</p>
	<p>Dr. K. Nanthakumar is Fellow at TERI. He has specialization in Environmental biotechnology: Bioenergy, Bioremediation of wastewater and soil, emerging pollutants management. His main research areas include the role of microorganisms in remediation of polluted environments including total petroleum hydrocarbon, emerging micro-pollutants, development of specialized micro electrochemical reactor system for the treatment of various wastewater and recovery of energy. Email: k.nanthakumar@teri.res.in</p>
	<p>Dr. Subhasis Das is a molecular microbiologist and Fellow at TERI and was a team member of the soil remediation project of TERI at Kuwait. His main areas of research is bioremediation of Xenobiotics, flame retardant compounds and other contaminants. He is a member of scientific society, Associate Editor of National and International Journal and examiner of Indian University. Email: subhasis.das@teri.res.in</p>
	<p>Dr. Omkar Nath Tiwari is Scientist E in the Department of Biotechnology, Government of India. He looks in the Environmental Biotechnology, River Cleaning programs, Bioresource Development program of the department. Email: omkar.dbt@nic.in</p>

Program Schedule of the Training Program

DAY: 1		December 4 2018
10:00 to 10:30	Registration	
10:30 to 11:00	Inauguration	
	Welcome address	Dr Prodipto Ghosh, Distinguished Fellow, TERI; Former secretary MoEF
11:00 to 11:15	TEA	
11:15 to 12:00	Scope of Biotechnology to manage Environmental issues	Dr. Vibha Dhawan
12:00 to 13:00	DBT initiatives in Bio-remediation to address environmental issues	Dr. Onkar Nath Tiwari
13:00 to 14:00	LUNCH	
14:00 to 15:00	Basics of Molecular Biology and Biotechnology	Dr. Sutapa Dutta
15:00 to 16:00	Application of environmental biotechnology knowledge	Md. Hafizur Rahman
16:00 to 16:15	TEA	
16:15 to 17:00	Innovating Wastewater Treatment in India	Dr. Nupur Bahadur
DAY: 2		December 5 2018
9:00 to 10:00	Visit to Different facilities of TERI at TERI-Gram	
10:00 to 10:30	TEA	
10:30 to 12:00	Discussion: Key issues of PCBs related to Air Quality Monitoring & Management	Dr. Divya Datt & Dr. Sumit Sharma
12:00 to 13:00	Biofuels – Importance, Potential and Present Status	Dr. K. Dheeban Chakravarthi
13:00 to 14:00	LUNCH	
14:00 to 15:00	Hydrogen production through biological route	Dr. Sanjukta Subudhi
15:00 to 16:00	Environmental bioremediation: A method for clean-up of Environmental pollutants	Dr. K. Nanthakumar
16:00 to 16:15	TEA	
16:15 to 17:00	Cutting edge technologies for the sustainable management of wastewater	Dr. Punarbasu Chaudhury
DAY: 3		December 6 2018
10:00 to 11:00	Mitigation of pesticide pollution through Microbial Bioremediation Technology	Dr. Subhasis Das
11:00 to 11:15	TEA	

11:15 to 12:00	New age nanotechnology application and beyond	Dr. Md. Azizur Rahman
12:00 to 13:00	Composting of municipal solid waste	Prof. Satyawati Sharma
13:00 to 14:00	LUNCH	
14:00 to 15:30	Bio-tech products to address different environmental issues	Dr. Banwari Lal
15:30 to 15:45	TEA	
15:45 to 16:15	Submission of Feedback form	
16:15 to 16:45	Certificate distribution & concluding remark	Dr. Pradipto Ghosh; Dr. Omkar Nath Tiwari; Dr. Banwari Lal

List of Participants in the Training Program

Nominations were requested from various State pollution control boards, pollution control committees and other relevant organisations and institutes in the month of July 2018. The final list of nominations was submitted to CPCB for approval in October 2018. Based on the approved list of participants received from the CPCB in the month of November 2018, invitations to attend the training program were sent. The approved list of participants from CPCB is attached in Annexure-I. Detail of the participants in the training program is given below,

B.M. Sreedhar Naik	Karnataka State Pollution Control Board	sridharkpsc@gmail.com
Ch. Jyothi Manohar	Andhra Pradesh Pollution Control Board	jyotimanohar.cheeli@appcb.gov.in
Deepesh V.	Central Pollution Control Board, Bangalore	deepesh.cpcb@nic.in
Hitender Sharma	Himachal Pradesh State Pollution Control Board	hitender1968@rediffmail.com
Huzaiifa Lokhandwala	Gujarat Pollution Control Board	ev.huzaiifa@gmail.com
K.Vijaya Mohan	Andhra Pradesh Pollution Control Board	unit2-aeel@appcb.gov.in
M. Y. Ansari	Central Pollution Control Board, Delhi	mycpcbdelhi@gmail.com
Manoj Kumar Sharma	Central Pollution Control Board, Vadodara	mks_cpcb@rediffmail.com
Mansinh B. Jadav	Gujarat Pollution Control Board	mbjadav.gpcb@gmail.com
Omprakash Shaw	Central Pollution Control Board, Delhi	academics.opshaw@gmail.com
P. D. Khadkikar	Maharashtra Pollution Control Board	padmanabh.khadkikar@mpcb.gov.in
P. K. Kar	Odisha State Pollution Control Board	rospcb.rayagada@ospcb.org
Pradeep Kumar	Central Pollution Control Board,	pradeepbest101@gmail.com

	Lucknow	
Pratim Khare	Madhya Pradesh Pollution Control Board	rlmppcbujain@gmail.com
Ravi Gali	Karnataka Pollution Control Board	ravigali13@gmail.com
Shekhar Chandra	Central Pollution Control Board, Delhi	shekharj1968@gmail.com
Simanchal Dash	Odisha State Pollution Control Board	sdash@ospcboard.org
Sunil Salve	Maharashtra Pollution Control Board	soaurangabadlab@mpcb.gov.in
Surendra G Karankar	Maharashtra Pollution Control Board	sochandrapurlab@mpcb.gov.in

Nineteen (19) out of twenty (20) approved participants were participated in the training program. Daily registration sheet of the participants is attached in Annexure –II.

Detail of the Training Program

The training program was organized at the TERI-Gram, Gual Pahari, Gurugram, Haryana. All participants in the training program was provided double shared accommodation for the entire duration of the training program at RETREAT (Resource Efficient TERI Retreat for Environmental Awareness and Training) building located within the lush green campus of TERI-Gram.

A printed course material was provided to all participants during the training program. A copy of the course material is attached with this report. Additionally, soft copies of all power point presentations (in PDF) by the faculties and photographs were also provided to all participants through cloud share. A printed copy of all presentations during the training program is also attached with this report. Detail of the training program is given below,

First day of the Program

In his welcome address to the participants, Dr Prodipto Ghosh, distinguished Fellow TERI and former secretary, MoEF, Government of India, mentioned about current issues related to pollution in terms of air, water and land. In recent times, pollution has emerged as concerned issue due to its devastating effects on nature and environment. Biotechnology has a brought aspect of application in terms of controlling pollution to environment. He mentioned that 'Environment Biotechnology' means controlling or cleaning up of environment through utilization of natural species and microbes. To conclude his welcome address he mentioned that the future of biotechnology in India on controlling environment does depend on the initiatives taken by researchers and regulators like pollution control board officials.



Dr. Prodipto Ghosh addressing the participants in his welcome address

Dr Vibha Dhawan addressed some facts related to scope of biotechnology in controlling environmental issues. She mentioned about role played by wide range



Dr. Vibha Dhawan addressing the participants

microbes- bacteria, fungi, actinomyces and earthworms in bringing degradation of pollutants present in our society. In India, there is huge scope for utilizing resourceful microbes for not only creating pollution free environment but also to generate value added products. This session before lunch was very interactive with the participants.

The lecture on the basics of Biotechnology and Molecular biology was delivered by Dr Sutapa Dutta in the afternoon session. She gave brief description on evolution of cell, its components, functions and molecular basis of cell- DNA, RNA, amino acids, proteins etc. Since microbial activity plays major in degrading a pollutant therefore she highlighted the necessity for knowing functioning of cell, metabolic activity, pathway and synthesis of enzymes, proteins.



Dr. Sutapa Dutta addressing the participants

In a very interactive lecture with the participants, Dr Nupur Bahadur described the application of nanotechnology for waste water treatment mainly focusing on importance of new nano based materials for reducing high organic and chemical load present in different effluents coming from textile and dyes industries.

Participants were discussed with Dr. Nupur about the possibilities of implementation of this technology in the ETPs of different industries relevant to their respective locations.

In the final lecture of the opening day, Md Hafizur Rahman described different application of biotechnology in controlling air, water and soil pollution.



Presentation by Dr. Nupur Bahadur and Md. Hafizur Rahman

Second day of the Program

The second day of the training program began with visit to different environmentally sustainable facilities of TERI-Gram in the wee hours.



Participants at the phobioreactor facility of TERI-Gram

Dr Dheeban Chakravarthi delivered a lecture focussing on importance, potential and present status of biofuels in India. He mentioned about the potential of algae on biofuel production broadly describing on culture technique, harvesting and methods of biofuel production. Later, participants visited the photobioreactor facility of TERI-Gram with Dr. Dheeban to understand the process of algal cultivation and harvesting.

The microbial pathway to produce enzymes and potential to produce hydrogen was described by Dr Sanjukta Subudhi. She mentioned the potential of waste material like water hyacinth to produce hydrogen gas for the purpose of commercial use. Dr Nanthakumar delivered lecture on different bioremediation methods for addressing environmental pollution. He briefly described on principle and different techniques of bioremediation to control various environmental pollution.



Presentation by Dr. Sanjukta Subudhi and Dr. K. Nanthakumar

Dr Punarbasu Chaudhuri described cutting edge technology of Kolkata for sustainable management of sewage water during the late evening hour lecture. He addressed the concept of sustainability in waste water management and integrated resource recovery from waste water by setting “East Kolkata wetlands” project as a case study. However, he also mentioned that it is difficult to mimic the same in other parts of the country as in most of the other urban areas sewage water is mixed with

the industrial waste water. The lecture was very enlightening and participants continue discussion with the faculty late in the evening.



Presentation by Dr. Punarbasu Chaudhury

Third day of the Program

The final day of the training program began with the lecture of Dr Shubashis Das on mitigation of pesticide pollution through bioremediation technology. He gave brief explanation on history of pesticides development and manufacturing scenario in India largely focusing on role of novel bacteria in reducing fate and effects of pesticide contamination in agriculture fields.



Presentation by Dr. Subhasis Das

Prof. Satyawati Sharma delivered a lecture on rapid composting technique for municipal solid waste. She gave brief explanation on aerobic and anaerobic

composting of solid wastes with broadly emphasising the process, design aspects, utility of microbes and potential of vermicomposting.



Presentation by Prof. Satyabati Sharma

Dr Md Azizur Rahman's lecture was on the structural uniqueness of diatom exoskeleton, namely, frustules. In the lecture, Dr Rahman vividly explained the various characteristics physical and chemical of the structure. He also explained the uses of frustule in the field of Dye sensitized solar cells (DSSC), environmental gas detection and wastewater treatment of photo catalytic dye and Cr(VI)



Presentation by Dr. Md. Azizur Rahman

components. The lecture also drew attention in the integrated approach of recovery

of bioactive compounds from diatoms and the addition use of exoskeleton in the action specific development.

In the post lunch session, Dr Banwari Lal, described the oil zapper technology in degrading petroleum hydrocarbons thereby controlling oil spillage problems. He lecture was focussed on development, benefits and utilization of oil zapper in oil industry for cleaning process.



Dr. Banwari Lal presenting the Oil Zapper technology

In the last lecture of the training program Dr. Omkar Nath Tiwari describe the scope of different project funding available with the Department of Biotechnology, Government of India. He also mentioned the achievement of the department in addressing different issues related to environmental pollution. Participants were very interactive in this session too. According to the participants this was a completely new information to them, earlier they were not aware about such research development in the country.



Dr. Onkar Nath Tiwari presenting DBT's role in managing environmental pollution

The valedictory session was chaired by Dr Prodipto Ghosh and Dr Omkar Nath Tiwari and Dr Banwari Lal were also participated in the session. The participants suggested that mostly product based study or case study must be focussed in the training program. They also mentioned that application based studies should be included since participants of training programme were mostly practitioners but not researchers. Participant from HPSPCB had suggested on resource recovery from waste water must be highlighted and mainly effluents with high content COD released from pharmaceutical, dye and dye-intermediate industries can be treated with the technology that Dr. Nupur Bahadur had demonstrated. Some participants did ask about mechanism for plastic degradation or any solution related biodegradation by utilization of microbes. Dr. Lal even referred micro plastic is a major concern where complete degradation is not achievable.

Dr. Ghosh mentioned that the research programme proposal must come from industries through the CPCB/SPCBs to the funding institutes like DBT and research institute like TERI, CSIR etc. which can provide technology solutions to different industrial problems.

Dr Tiwari added in the valedictory session that the regulators like CPCB, funders like DBT must directly interact and collaborate among themselves to produce better solution to mitigate the polluted environment. Communications must be carried out directly by industries to researchers to generate outcome. He also emphasized that the facilitation and demonstration along with adoption of any technology is widely required. Dr Ghosh in concluded the training program with a note that the participants will try to facilitate the interaction of regulators with researchers and industries following their learning in the exhaustive training sessions of three days.

Dr. Ghosh, Dr. Tiwari and Dr. Lal distributed the participation certificate.



Distribution of participation certificates

Conclusion

The training program was successful and highly appreciated by the participants. The training program was effective in making participants familiar with the different aspects of environmental biotechnology with exposure to few of the in-field exercises. The participation was satisfactory and full-house was recorded till the valedictory session of the program. The participants enthusiastically took advantage of the program and dedicatedly attended all lectures. Analysis of the feedback received from the participants speaks about the need of further extension of the program in more advanced and exhaustive manner. Participants had emphasized on more laboratory and field visits and case studies for the inclusion in the course module, keeping the basic learning away from the module. Participants have appreciated the gender distribution in the faculties. TERI will be pleased to offer its services and expertise in giving further training on this emerging subject.

Photo Gallery





Annexure: I – Approved List of Participants

Annexure: II – Daily Registration Sheets

Annexure: III – Feedback of Participants

