
Environment at Crossroads

Challenges and Green Solutions

— Arun Arya —



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Prof. Arun Arya

Head (Retd.)

Department of Environmental Studies

The Maharaja Sayajirao University of Baroda
Vadodara



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In the loving memory of Er. Shri O.P. Arya (1-12-1935 – 15-3-2005)

हस्तियाँ मिट जाती हैं
आशियाँ बनाने में,
बहुत मुश्किल होती है
अपनों को समझाने में,
एक पल में किसी को भुला मत देना
जिन्दगी लगा दी जिन्होंने
समाज को बनाने में,
हम सब को प्रगति के पथ पर
बढ़ाने में।
नगरों को बनाने
और बागों को सजाने में।

Shubhanginiraje Gaekwad
CHANCELLOR



The Maharaja Sayajirao University of Baroda

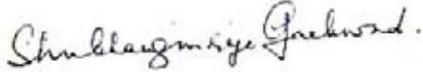
FOREWORD

Earth's climate has changed during its evolutionary history, resulting into five mass extinctions. Scientists have observed loss of more than 75% species, in these extinctions. Now the environmental pollution has threatened the survival of plants, animals and human lives. Climate directly affects the survival of biodiversity. The warmer world may induce geographic expansion of certain group of organisms like insects, fungi etc. potentially changing the landscape of infectious diseases. Cases of vector-borne diseases the dengue, malaria and swine flu have increased in recent years and are responsible for large number of human lives.

Air pollution is a global problem that causes premature mortality, damage to crops and changes in ecosystem. It is estimated that in developing world, air pollution alone contributes to the death of more than 800 thousand people every year. Municipal solid waste, used as land fill, can be converted into useful compost or may be converted into source of energy. Disseminating recent scientific knowledge is important in order to sensitive scientists, students and public. In this regard an edited volume entitled, "Environment at Crossroads: Challenges and Green Solutions: by Prof. Arun Arya, Ex-Head Department of Environmental Studies. The Maharaja Sayajirao University of Baroda is a welcome academic effort.

The present volume encompasses 25 well-written chapters on various aspects of pollution management and bio-diversity conversation. Chapters include pollution caused by vehicles, dust and cement dust, food allergy as well as diseases caused by fungi. An article on pollution of the river Vishwamitri, in Vadodara, is included. The volume includes chapters dealing with molecular aspect of stress related genes in plants.

I am sure that edited volume will attract the attention of environmental scientists, biologists, biotechnologists and city planners. It will be useful to educate students, protect organic objects from deterioration, reduce pollution and make life better, I compliment Prof. Arya on this book and I am hopefully it will solicit the response it deserves.



Shubhanginiraje Gaekwad
CHANCELLOR

Contents

Foreword

Preface

A : Environmental Pollution and Microbes

- 1 Use of fast growing white wood rotting fungus *Ganoderma lucidum* (L.) Karst. for Cultural and Bioremediation Studies
— Arun Arya, Chitra Arya and Pradyut Dhar 1
- 2 A look into dark side of fungal agents : Researches on Human Diseases
— Varsha Raimalani and Brinda Panchamia 10
3. Occurrence of Fungal Endophytes inhabiting the leaves of three *Terminalia* spp.
— Pradyut Dhar and Arun Arya 24
4. Role of microbes in Biodeterioration of Museum objects in Gujarat
— Arun Arya 32
5. Effect of cement dust pollution on the colonization of leaf surface microorganisms
— Arun Arya and Ankita Bhatt 40
6. Studies on seed borne diseases of *Cicer arietinum* (Chick pea) and trials with fungus *Trichoderma* as bio control agent against *Fusarium* sp.
— Niharika Nema and Arun Arya 47
7. Integrated Management of Bakanae disease in Basmati Rice
— Anuja Gupta and Ravindra Kumar 55
8. Response of selected endophytic fungi to different abiotic stresses isolated from *Syzygium cumini* of eastern Uttar Pradesh, India
— Sharma V.K., Kumar J., Singh D.K., Mishra A., Gond S.K., Verma S.K., Kumar A., Singh, K. and Kharwar R.N. 71
9. Status of Aeromycoflora and Aeroallergens in the Vadodara City
— Bablu Prasad and Arun Arya 91

B: Climate Change and Sustainable Development

10. Effect of Fluorspar mining waste on germination and Plant Growth of *Zea mays* and *Vigna radiata*
— *Disha Thakkar and Arun Arya* 101
11. Toxicological potentials of heterogenous chemical mixtures
— *Kauresh D. Vachhrajani and Kiran Morya* 112
12. Organic Farming a new way to increase the Basmati Rice Production
— *Shakuntala E. Pillai and Ravinayak Patlavath* 128
13. Intelligent traffic and fast transport system to reduce vehicular pollution in urban areas
— *Arun Arya* 140
14. Be aware of Pollen, Fungal and Food Allergens
— *V.M. Raole* 147
15. Allelopathic effects of *Sesamum indicum* L. on *Cyperus rotundus* L.
— *N.B. Singh and Sunaina* 168
16. Clean up Strategy for the River Vishwamitri
— *V.S. Patel* 178
17. Removal of copper (II) from aqueous solution by using CSCMQ
— *Prapti U. Shah, Nirav Raval and Hitesh Solanki* 191
18. The role of polyamines during environment stresses in plants
— *Manisha Farsodia and Sunil Kumar Singh* 218

C: Environmental Problems and Solutions

19. Forests and Biodiversity Conservation: A Religious Perspective
— *Prof. S.D. Sabnis* 233
20. Role of *Casuarina* in soil conservation along sea coast of Gujarat
— *Shalini Ojha* 236
21. Essential oils as next generation fungicides: Contrivances and Challenges
— *Akash Kedia, A.K. Dwivedy and Nawal Kishore Dubey* 249

22. Threatened and Endemic plant diversity of India	
	<i>— M. Daniel and P.S. Nagar</i> 262
23. Endangered animals of Gujarat and their conservation	
	<i>— Ankita Bhatt and Neha Singh</i> 273
24. Yagna an Ancient Indian Tradition for keeping environment clean	
	<i>— Arun Arya and Chitra Arya</i> 281
25. Surface Modified Magnetic Nanoparticles: A New Generation of Nanoadsorbents for Facile Remediation Protocols	
	<i>— Monika Yadav, Manita Das, Sonal Thakore and Rajendrasinh N. Jadeja</i> 291
Subject Index	312

Preface

The increase of global human population and the enhanced world wide environment pollution has been a grave concern in each corner of the planet. It seems that we have been challenging the testing limits of the planet with ever increasing threshold of environmental toxicants, pollutants, mutagens, carcinogens, teratogens and clastogens. In pursuit of greater profit margins we have been cutting corners without realizing that our activities will come back and haunt us for the repeated mistakes we have been making in mishandling environmental issues. In other words, we have been consciously sweeping the burning problems under the carpet and just been looking towards God. We were flooded by calamity of natural and man made disaster-floods throughout the country. This shows our poor planning after 70 years of independence. We have perfectly acted as ignorant individual for a long time and were not ready to come face to face with the crude and ugly truth hovering behind our back. However, everything has a breaking point and finally the house of cards starts falling apart in front of those same eyes which were so professionally been trained to ignore their warning symptoms across the past decades.

This is one of the realities that we are currently facing world-wide, because of the short term gains, we have ignored the long term sustainable aspect of our fragile ecosystems and the environment. Be it loss of precious natural resources or biodiversity or extensive pollution halting an industrial operation or destruction of a virgin forest due to slash and burn method agriculture; the final impact is always the same. The impact being loss of livelihood, employment opportunities, social and economic instabilities, poor health and vengeance full local environment and a hopeless future. We choose to be ignorant when we should have responded and the nature takes its toll in due time. Hence it is important to understand and appreciate the challenges of extensive environment pollution and ecological degradation and to take responsibility and leadership to cope with such challenges rather than avoiding them.

Students and researchers in areas of Environmental Sciences and Applied Environmental Studies and will cater to the needs of academics and researchers involved in finding sustainable solutions to global environmental issues including loss of biodiversity, intelligent traffic and health foods. The author gratefully acknowledges the kind support, help, cooperation of all the authors and peer reviewers involved in the project for their contributions and constructive criticisms,

The author(s) are solely responsible for the thoughts, opinions, views and information provided in different chapters of this volume. Any copyright infringement or plagiarism act is the sole responsibility of the authors. Hope the readers will enjoy the volume.

Arun Arya

Ex- Head, Env. Studies
The Maharaja Sayajirao University of Baroda,
Vadodara (Gujarat), India

A: Environmental Pollution and Microbes

स्वच्छ पर्यावरण

कुछ ऐसा हम करें
कि चारों ओर हो हरियाली,
वनों में सिंह गरजें
बागों में नाचें मोर
जैव विविधता न बने कोरा नारा,
हम भावी पीढ़ी के लिये छोड़ें
वातावरण न्यारा ।
रोकें उपयोग रसायनिक खादों का
जैव उर्वरकों का हो बोलबाला
कमी हो रसायनिक कीट नाशकों की,
हम बनायें वातावरण सुन्दर
जैव उर्वरकों का प्रयोग
न केवल धरती की उर्वरता बढ़ायेगा
एक नया स्वर्णिम अध्याय
गांव—गांव में लिखा जायेगा,
अपना भारत फिर स्वच्छ
एवं स्वस्थ बन जायेगा ।

Chapter - 1

Use of fast growing white wood rotting fungus *Ganoderma lucidum* (L.) Karst. for Cultural and Bioremediation Studies

Arun Arya, Chitra Arya and Pradyut Dhar¹

Environmental Science, Faculty of Science,
The Maharaja Sayajirao University of Baroda, Vadodara-390002, India.

¹Department of Botany, Faculty of Science,
The Maharaja Sayajirao University of Baroda, Vadodara-390002, India.
E mail: sarojarun10arya@rediffmail.com,

ABSTRACT

A new development in the field of environmental biotechnology is the microbe based sorbents for the removal and recovery of heavy metals from the industrial waste water. Heavy metals as widespread pollutants is of great environmental concern as they are non-degradable and persistent. Many of these metals are toxic and hazardous. The term biosorption is defined as a process in which solids of natural origin are used.

Pollution from metals is very common, as they are used in many industrial processes such as electroplating, textiles, paint and leather. The wastewater from these industries is often used for agricultural purposes, so besides the immediate damage to the ecosystem it is spilled into, the metals can enter far away creatures and humans through the food chain. Mycoremediation is one of the cheapest, most effective and environmental-friendly solutions to this problem. Many fungi are hyperaccumulators, that means they are able to concentrate toxins in their fruiting bodies for later removal. This is usually true for population that have been exposed to contaminants for long time, and have developed a high tolerance, and happens via biosorption on the cellular surface, which means that the metals enter the mycelium in a passive way with very little intracellular uptake. A variety of fungi, such as *Pleurotus*, *Aspergillus*, *Trichoderma* have proven to be effective, in removal of toxic metals from wastewater and on land. Not all the individuals of a species are effective in the same way in the accumulation of toxins. The single individuals are usually selected from an old-time polluted environment, such as sludge or wastewater, where they had time to adapt to the circumstances, and the selection is carried on in the laboratory. A dilution of the water can drastically improve the ability

of biosorption of the fungi. The capacity of certain fungi to extract metals from the ground also can be useful for bioindicator purposes, and can be a problem when the mushroom is an edible one. For example, the shaggy ink cap (*Coprinus comatus*), a common edible north-hemisphere mushroom, can be a very good bioindicator of mercury, and accumulate it in its body, which can also be toxic to the consumer. Chapter presents the account of biosorption potential of *Ganoderma* mushroom

Keywords: White wood rotting fungus, *Ganoderma lucidum*, Cultural and Bioremediation Studies

1.1 INTRODUCTION

Analysis of heavy metals in wastewater is important because of their significant role in various complex processes, such as surface soil and water loading, bioaccumulation in living organisms, it acts as atmospheric catalyst and results in increase in the frequency of air and water-borne diseases. There is continuous increase in concentration of trace metals in the atmosphere. The metals in the hydrosphere are of environmental importance because of their interactions with solid geological materials, their influence on biological processes and their interactions with the atmosphere by evaporation processes. Biosorption is a technology that represents an alternative to conventional water treatments for heavy metal recovery. This technology allows the reuse of agricultural and industrial residue. Basically the term biosorption describes the removal of polluting agents from aqueous solutions by using biomass.

The commonly used procedure for metal removal are

Reverse Osmosis: It is a process in which heavy metals are separated by semi permeable membrane at a pressure greater than osmotic pressure caused by dissolved solids in wastewater. The disadvantage is that the method is expensive.

Electrodialysis: In this process, the heavy metals are separated through the use of semipermeable ion selective membranes. Application of an electrical potential is done between two electrodes. The main disadvantage of this process is formation of metal hydroxides, which clog the membrane.

Ultrafiltration: filtration is facilitated by membrane operations that use porous membranes for the removal of heavy metals. The main disadvantage of this process is generation of sludge.

Ion-exchange: In this process, metals ions from dilute solution are exchanged with ions held by electrostatic forces on the exchange resin. The disadvantages include, high cost and partial removal of certain ions.

Chemical Precipitation: Precipitation of metals is achieved by the addition of coagulants as alum, lime, iron salts etc. The large amount of sludge containing toxic compounds produced during the process is main disadvantage.

Phytoremediation; use of certain plants to clean up toxic metal pollutants.