

Strategies for Sustainability

Series Editors

Lawrence Susskind

Ravi Jain

For further volumes:

<http://www.springer.com/series/8584>

Strategies for Sustainability

Aims and Scope

The series, will focus on “implementation strategies and responses” to environmental problems – at the local, national, and global levels. Our objective is to encourage policy proposals and prescriptive thinking on topics such as: the management of sustainability (i.e. environment-development trade-offs), pollution prevention, clean technologies, multilateral treaty-making, harmonization of environmental standards, the role of scientific analysis in decision-making, the implementation of public-private partnerships for resource management, regulatory enforcement, and approaches to meeting inter-generational obligations regarding the management of common resources. We will favour trans-disciplinary perspectives and analyses grounded in careful, comparative studies of practice, demonstrations, or policy reforms. We will not be interested in further documentation of problems, prescriptive pieces that are not grounded in practice, or environmental studies. Philosophically, we will adopt an open-minded pragmatism – “show us what works and why” – rather than a particular bias toward a theory of the liberal state (i.e. “command-and-control”) or a theory of markets.

We invite Authors to submit manuscripts that:

Prescribe how to do better at incorporating concerns about sustainability into public policy and private action.

Document what has and has not worked in practice.

Describe what should be tried next to promote greater sustainability in natural resource management, energy production, housing design and development, industrial reorganization, infrastructure planning, land use, and business strategy.

Develop implementation strategies and examine the effectiveness of specific sustainability strategies. Focus on trans-disciplinary analyses grounded in careful, comparative studies of practice or policy reform.

Provide an approach “...to meeting the needs of the present without compromising the ability of future generations to meet their own needs,” and do this in a way that balances the goal of economic development with due consideration for environmental protection, social progress, and individual rights.

The Series Editors welcome any comments and suggestions for future volumes

SERIES EDITORS

Lawrence Susskind

susskind@mit.edu

Professor Ravi Jain

rjain@pacific.edu

Abdul Malik • Elisabeth Grohmann
(Editors)

Environmental Protection Strategies for Sustainable Development

 Springer

Editors

Abdul Malik
Department of Agricultural Microbiology
Aligarh Muslim University
Aligarh 202002
India
ab_malik30@yahoo.com

Elisabeth Grohmann
Department of Infectious Diseases
University Hospital Freiburg
Hugstetter Straße 55
79106 Freiburg
Germany
elisabeth.grohmann@uniklinik-freiburg.de

ISBN 978-94-007-1590-5 e-ISBN 978-94-007-1591-2

DOI 10.1007/978-94-007-1591-2

Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2011932795

© Springer Science+Business Media B.V. 2012

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs. Sustainability is the key to preventing or reducing the effect of environmental issues. Environmental sustainability is the process of making sure current processes of interaction with the environment are pursued with the idea of keeping the environment as pristine as naturally possible based on ideal-seeking behavior. Ecosystems are dynamic interactions between plants, animals, and microorganisms and their environment working together as a functional unit. Ecosystems will fail if they do not remain in balance. No community can carry more organisms than its food, water, and shelter can accommodate. Food and territory are often balanced by natural phenomena such as fire, disease, and the number of predators. Each organism has its own niche, or role, to play. The environment of our planet is degrading at an alarming rate because of non-sustainable urbanization, industrialization and agriculture. Our air, water, land and food are polluted. Pollution rate has exceeded the manageable capacity of nature at many places. Almost 50% of the land is eroded and robbed of its fertility. The extent of damage done to the world's biological diversity and ecosystem cannot be assessed. Our renewable and non-renewable resources are being alarmingly exhausted due to increasing population pressure posing difficulty to manage threat to future generation. Environmental issues are receiving utmost attention and have been debated at various international forums e.g. the first Earth Summit held in Stockholm, Sweden in June 1972; the second one in Rio de Janeiro, Brazil in 1992. The European Council in Göteborg (2001) adopted the first EU Sustainable Development Strategy (SDS). This was complemented by an external dimension in 2002 by the European Council in Barcelona in view of the World Summit on Sustainable Development in Johannesburg (2002), the Montreal and Kyoto Protocols etc. The European Council of June 2006 adopted an ambitious and comprehensive renewed Sustainable Development Strategy (SDS) for an enlarged EU. The European Commission adopted in October 2007 the first progress report on the Sustainable Development Strategy and in July 2009 reviews of EU SDS. Declarations of far reaching consequences were made at these summits. But current approaches in environmental protection have shifted from the end of pipe mitigation to zero emission strategies and to 3 R's: reduce, reuse and recycle waste.

Every nation desires economic growth, and at the same time it craves for eco-conservation and sustainable development. Administrative authorities are required to frame plans, programs and policies for a better scientific and technological development of production, distribution and consumption processes with sustainability. Green technology concepts are emerging as the future strategy for environmental management. It has become a challenge for scientists to devise remedial measures to control pollution levels and safeguard the future.

The book has seventeen chapters and attempts to present balanced accounts on various strategies for sustainable development. Chapter 1 gives an overview of different environmental protection strategies for sustainable development, while Chap. 2 describes the potential of rhizospheric microorganisms in the sustainable plant development in anthropogenic polluted soils. Other chapters deal with bioremediation of pesticides from soil and wastewater, remediation of toxic metals from soil, biological treatment of pulp and paper industry wastewater, sustainable solutions for agro processing waste management, impact of solid waste management on climate change and human health, environmental impact of dyes and its remediation. Various methods for genotoxicity testing of environmental pollutants are also discussed. Separate chapters have been devoted to molecular detection of resistance and transfer genes in the environmental samples, and biofilm formation by the environmental bacteria. Chapters on biochemical attributes to assess soil ecosystem sustainability, application of rhizobacteria in biotechnology, role of peroxidases as a tool for the decolorization and removal of dyes are also included. The role of biopesticides in sustainable agriculture is dealt in detail in the last chapter.

The book is not an encyclopedic review. The chapters incorporate both theoretical and practical aspects, and serve as baseline information for future research through which significant developments can be expected. This book will be of great interest to the research scientists, students, teachers, and environmental engineers working in the area of Environmental microbiology, ecotoxicology, soil microbiology, biotechnology and agricultural microbiology and would also serve as a valuable resource for environmental regulatory and protection agencies.

With great pleasure, we extend our sincere thanks to all our well-qualified and internationally renowned contributors from different countries for providing the important, authoritative and cutting edge scientific information/technology to make this book a reality. All chapters are well illustrated with appropriately placed tables and figures and enriched with up to date information. We are also thankful to the reviewers who carefully and timely reviewed the manuscript.

We are extremely thankful to Springer, Dordrecht, the Netherlands for completing the review process expeditiously to grant acceptance for publication. We appreciate the great efforts of the book publishing team especially Tamara Welschot, Senior Publishing Editor Environmental Sciences and Prof. Ravi Jain, Series Editor, Strategies and Sustainability in responding to all queries very promptly.

We express sincere thanks to our family members for all the support they provided, and regret the neglect and loss they suffered during the preparation of this book.

Abdul Malik
Elisabeth Grohmann

About the Editors



Dr. Abdul Malik is Chairman, Department of Agricultural Microbiology, Aligarh Muslim University, Aligarh, India. He received his Ph.D. Degree in Agricultural Microbiology from Aligarh Muslim University, Aligarh, India. Dr. Malik has been awarded several Fellowships and honors including DAAD fellowship (Germany), BOYSCAST overseas Fellowship, Jawahar Lal Nehru Memorial Fund award etc. He has been awarded Young Scientist project of Department of Science & Technology, Govt. of India twice. Dr. Malik has visited Technical University Berlin as Visiting Scientist in 2006, 2008 and 2009 and Uni-

versitätsklinikum Freiburg im Breisgau, Germany in 2010 under DAAD research programme. He has collaborative projects with Technical University Berlin, Germany and University of Minho, Braga, Portugal. He has received research grants from several funding agencies of the Govt. of India including DST, CSIR, UGC as Principal Investigator. His major areas of Research are Environmental Microbiology, Ecotoxicology, conjugative plasmids in bacteria, degradation of pesticides. Dr. Malik has published a number of research papers in leading scientific journals with high impact factor.



Dr. Elisabeth Grohmann is Group Leader, Department of Infectious Diseases, University Hospital Freiburg, Germany. She received her Ph.D. degree in Molecular Biology and Biochemistry from Technical University, Graz, Austria. She completed her habilitation (*Venia legendi*) at the Faculty of Process Sciences/Department of Environmental Engineering of the Technical University, Berlin Germany. She has been awarded an Erwin-Schrödinger post doctoral fellowship. Up to February 2010 she was Molecular Biology Group Leader at the Technische Universität Berlin. She has received research grants from

DFG, BMBF, EU, ESA, DLR etc. She has collaborative projects with Karl-Franzens-University, Graz, Austria, with universities and research centers in Belgium, USA, The Netherlands, Italy, Spain, Argentina, Chile, Norway, Mexico, Turkey and India. Her thrust area of research is conjugative plasmids (molecular mechanisms of DNA transfer) in bacteria. Dr. Grohmann has published a number of research papers in leading scientific journals with high impact factor in different research fields, bacteriology, environmental microbiology, biochemistry and molecular biology.

Contents

1 Environmental Protection Strategies: An Overview	1
Abdul Malik, Mashihur Rahman, Mohd Ikram Ansari, Farhana Masood and Elisabeth Grohmann	
2 The Potential of Rhizosphere Microorganisms to Promote the Plant Growth in Disturbed Soils	35
Katarzyna Hrynkiewicz and Christel Baum	
3 Sustainable Solutions for Agro Processing Waste Management: An Overview	65
C. M. Ajila, Satinder K. Brar, M. Verma and U. J. S. Prasada Rao	
4 Dyes—Environmental Impact and Remediation	111
Luciana Pereira and Madalena Alves	
5 Molecular Detection of Resistance and Transfer Genes in Environmental Samples	163
Elisabeth Grohmann and Karsten Arends	
6 Key Biochemical Attributes to Assess Soil Ecosystem Sustainability	193
Vito Armando Laudicina, Paul G. Dennis, Eristanna Palazzolo and Luigi Badalucco	
7 Methods for Genotoxicity Testing of Environmental Pollutants	229
Farhana Masood, Reshma Anjum, Masood Ahmad and Abdul Malik	
8 Trends in Biological Degradation of Cyanobacteria and Toxins	261
Fatma Gassara, Satinder K. Brar, R. D. Tyagi and R. Y. Surampalli	
9 Bioremediation of Pesticides from Soil and Wastewater	295
Reshma Anjum, Mashihur Rahman, Farhana Masood and Abdul Malik	

10	Isolation and Characterization of Rhizobacteria Antagonistic to <i>Macrophomina phaseolina</i> (Tassi) Goid., Causal Agent of Alfalfa Damping-Off	329
	L. B. Guiñazú, J. A. Andrés, M. Rovera and S. B. Rosas	
11	Biofilm Formation by Environmental Bacteria	341
	Mohd Ikram Ansari, Katarzyna Schiwon, Abdul Malik and Elisabeth Grohmann	
12	Biochemical Processes of Rhizobacteria and their Application in Biotechnology	379
	M. S. Dardanelli, D. B. Medeot, N. S. Paulucci, M. A. Bueno, J. C. Vicario, M. García, N. H. Bensi and A. M. Niebyski	
13	Pulp and Paper Industry—Manufacturing Process, Wastewater Generation and Treatment	397
	Saima Badar and Izharul Haq Farooqi	
14	A Review of Environmental Contamination and Remediation Strategies for Heavy Metals at Shooting Range Soils	437
	Mahtab Ahmad, Sang Soo Lee, Deok Hyun Moon, Jae E. Yang and Yong Sik Ok	
15	Peroxidases as a Potential Tool for the Decolorization and Removal of Synthetic Dyes from Polluted Water	453
	Qayyum Husain and Maroof Husain	
16	Solid Waste Management Options and their Impacts on Climate Change and Human Health	499
	Muna Albanna	
17	Potential of Biopesticides in Sustainable Agriculture	529
	M. Shafiq Ansari, Nadeem Ahmad and Fazil Hasan	
	Index	597

Contributors

C. M. Ajila INRS-ETE, Université du Québec, 490, Rue de la Couronne, G1K 9A9, Québec, Canada

Muna Albanna Water and Environmental Engineering Department, German Jordanian University, P.O. Box: 35247, Amman 11180, Jordan
e-mail: Muna.Albanna@gju.edu.jo

Madalena Alves IBB-Instituto Biotecnologia e Bioengenharia, Centro Engenharia Biológica, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal
e-mail: madalena.alves@deb.uminho.pt

J. A. Andrés Laboratorio de Interacción Planta-Microorganismo, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta 36 Km 601, Río Cuarto, Argentina

Reshma Anjum Department of Agricultural Microbiology, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: reshmabiotec@gmail.com

Mohd Ikram Ansari Department of Agricultural Microbiology, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: ikram_ansari21@yahoo.com

M. Shafiq Ansari Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: mohdsansari@yahoo.com

Karsten Arends Department of Environmental Microbiology, Technical University Berlin, Franklinstrasse 28/29, 10587 Berlin, Germany
e-mail: karsten.arends@tu-berlin.de

Luigi Badalucco Dipartimento di Ingegneria e Tecnologie Agroforestali, University of Palermo, Palermo, Italy
e-mail: badalucc@unipa.it

Saima Badar Environmental Engineering Section, Department of Civil Engineering, Aligarh Muslim University, Aligarh-202002, India

Christel Baum Institute of Land Use, University of Rostock, Justus-von-Liebig-Weg 6, 18059 Rostock, Germany
e-mail: christel.baum@uni-rostock.de

N. H. Bensi Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

M. A. Bueno Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

M. S. Dardanelli Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina
e-mail: mdardanelli@exa.unrc.edu.ar

M. García Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

Fatma Gassara INRS-ETE, Université du Québec, 490, Rue de la Couronne, G1K 9A9, Québec, Canada
e-mail: mail: fatmagassara@yahoo.fr

Elisabeth Grohmann Department of Infectious Diseases, University Hospital Freiburg, Hugstetter Strasse 55, 79106 Freiburg, Germany
e-mail: elisabeth.grohmann@uniklinik-freiburg.de

L. B. Guiñazú Laboratorio de Interacción Planta-Microorganismo, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta 36 Km 601, Río Cuarto, Argentina
e-mail: lguinazu@exa.unrc.edu.ar

Fazil Hasan Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: fazilento10@gmail.com

Katarzyna Hryniewicz Department of Microbiology, Institute of General and Molecular Biology, Nicolaus Copernicus University, Gagarina 9, 89-100 Torun, Poland
e-mail: hrynk@umk.pl

Maroof Husain Department of Microbiology, School of Medicine, University of Colorado Health Sciences Center, Aurora, Colorado, USA

Qayyum Husain Faculty of Applied Medical Sciences, Jazan University, Jazan, Post Box 2092, Kingdom of Saudi Arabia
e-mail: qayyumbiochem@gmail.com

Izharul Haq Farooqi Department of Civil Engineering, Environmental Engineering Aligarh Muslim University, Aligarh-202002, India
e-mail: farooqi_izhar@yahoo.com

Jae E. Yang Department of Biological Environment, Kangwon National University, Chuncheon 200-701, Korea

Vito Armando Laudicina Dipartimento di Ingegneria e Tecnologie Agroforestali, University of Palermo, Palermo, Italy

Mahtab Ahmad Department of Biological Environment, Kangwon National University, Chuncheon 200-701, Korea
e-mail: mah_tabee@yahoo.com

Abdul Malik Department of Agricultural Microbiology, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: ab_malik30@yahoo.com

Mashihur Rahman Department of Agricultural Microbiology, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: mashihur@gmail.com

Masood Ahmad Department of Biochemistry, Faculty of Life Science, Aligarh Muslim University, Aligarh-202002, India
e-mail: masoodahmad1952@gmail.com

Farhana Masood Department of Agricultural Microbiology, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: farhanamasud4@gmail.com

D. B. Medeot Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

Deok Hyun Moon Department of Environmental Engineering, Chosun University, Gwangju 501-759, Korea

Nadeem Ahmad Department of Plant Protection, Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh-202002, India
e-mail: nadeem777in@yahoo.com

A. M. Niebyski Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

Eristanna Palazzolo Dipartimento di Ingegneria e Tecnologie Agroforestali, University of Palermo, Palermo, Italy

Paul G. Dennis Dipartimento di Ingegneria e Tecnologie Agroforestali, University of Palermo, Palermo, Italy

N. S. Paulucci Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

Luciana Pereira IBB-Instituto Biotecnologia e Bioengenharia, Centro Engenharia Biológica, Universidade do Minho, Campus de Gualtar, 4710-057, Braga, Portugal
e-mail: lucianapereira@deb.uminho.pt

U. J. S. Prasada Rao Department of Biochemistry and Nutrition, Central Food Technological Research Institute, Mysore 570020, India

S. B. Rosas Laboratorio de Interacción Planta-Microorganismo, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta 36 Km 601, Río Cuarto, Argentina

M. Rovera Laboratorio de Interacción Planta-Microorganismo, Facultad de Ciencias Exactas, Físico-Químicas y Naturales, Universidad Nacional de Río Cuarto, Ruta 36 Km 601, Río Cuarto, Argentina

Satinder K. Brar INRS-ETE, Université du Québec, 490, Rue de la Couronne, G1K 9A9 Québec, Canada
e-mail: satinder.brar@ete.inrs.ca

Katarzyna Schiwon, FG Umweltmikrobiologie/Genetik, Technische Universität Berlin, 10587 Berlin, Germany
e-mail: Katarzyna.Schiwon@tu-berlin.de

Sang Soo Lee Department of Biological Environment, Kangwon National University, Chuncheon 200-701, Korea

R. Y. Surampalli US Environmental Protection Agency, KS 66117 Kansas City, P.O. Box 17-2141 USA

R. D. Tyagi INRS-ETE, Université du Québec, 490, Rue de la Couronne, Québec, Canada G1 K 9A9

M. Verma Institut de recherche et de développement en agroenvironnement inc. (IRDA), 2700 rue Einstein, G1P 3W8 Québec, Canada

J. C. Vicario Departamento de Biología Molecular, Facultad de Ciencias Exactas, Físico-Químicas y Naturales. Universidad Nacional de Río Cuarto, Ruta Nacional N 36, Km. 601, CP X5804BYA Río Cuarto, Córdoba, Argentina

Yong Sik Ok Department of Biological Environment, Kangwon National University, Chuncheon 200-701, Korea
e-mail: soilok@kangwon.ac.kr