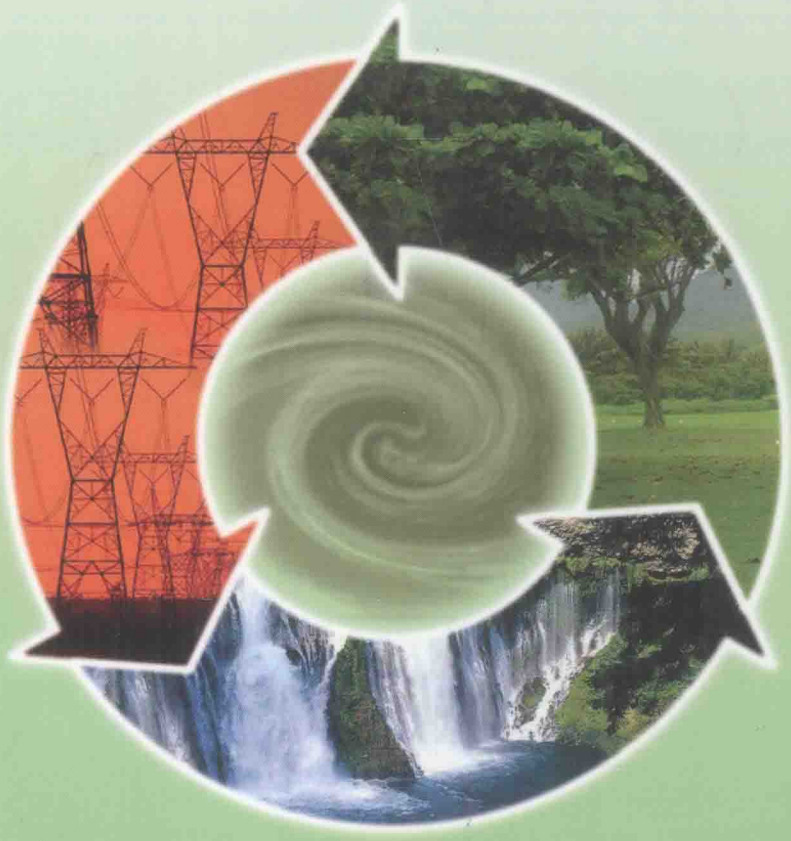
Sustainable Development

Environment, Energy & Water Resources



CRC Press
Taylor & Francis Group

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CRC Taylor & Francis
Taylor & Francis Group
Boca Raton London New York

CRC is an imprint of the Taylor & Francis Group,
an informa business

Ane Books Pvt. Ltd.

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First Published in 2011

Ane Books Pvt. Ltd.

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For

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway, NW, Suite 300
Boca Raton, FL 33487 U.S.A.
Tel : 561 998 2541
Fax : 561 997 7249 or 561 998 2559
Web : www.taylorandfrancis.com

For distribution in rest of the world other than the Indian sub-continent

ISBN : 978 1 43988 8254

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Printed at : Thomson Press (India) Ltd., Delhi

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To
my wife Sulekha
whose constant support saw the book through
three arduous years of its birth

Foreword

Contemporary times can hardly disown any facet of globalization; indeed, globalization is in a state of continual flux. Even its economic parenthood, as it were, has kept it alive through a variety of generations. Globalization, often revealingly or unwittingly has crept into sectors, which in turn, keep on acquiring different complexions. Perhaps, seeking a global identity may go on receding largely because of globality coupling itself with, and bringing in its trail, new forms that couldn't be made discernible earlier. Identification on this score is really an onerous task and becomes all the more complicated and worthwhile too, when such intermingling pose as challenges. Global Challenges, as the main title of the book, may seem to be transitory occurences. Hence, the book cannot but be legitimately fascinating. The title makes the job a fairly challenging proposition. The author has ably met it.

There can always be desirable proclivity from the post-Kyoto framework, but that the Protocol did unleash a genre of climate fix, is not often realized. Any post-Kyoto Protocol framework has to reckon discourses on energy security and climate change. The transitory aspect, as mentioned in the above lines on globalization, is currently taken care of by the most recent COP-14 in Poznan, Poland and so the timely presentation through this book, of the elements or areas that can hardly be decoupled. The concern for mitigating the impact on humanity of the climate change is becoming unbearingly difficult. The detail, however monotonous they may appear, of how to go about limiting carbon emissions and often simultaneously putting a price on activities harmful to environment, continue to be intriguingly deliberated.

Professor Ghosh Roy seems to be favouring a new sort of hierarchy in his list of the challenges segment. Sustainable development, historically speaking, emerged as a concept because of the World Commission of Environment and Development, under the aegis of the United Nation, way back in 1982. While the environment as a vital concept came up a decade ago in the well-known Stockholm Conference, CSD (Commission on Sustainable Development) had the follow-ups as CSD-1 in 1993 and CSD-12 in 2004. Climate change, global warming etc., came well within the purview of such get-togethers. The interface between energy and environment is well fathomed in this treatise. UN Millennium Development Goals can hardly be missing in the semi-textual presentation in the book. Policy matters, economic or sociological, can in no way, be dispensed with, as borne out by some of its adroitly well put up sections. That appallingly ubiquitous scarcity of water

resources can occur, which is likely to be ignored, has been excellently posed as challenges. Energy needs have to have an overriding priority among the categories of four concerns considered by the Author.

Dr. Bjorn Lomberg in his marvellous book *The Sceptical Environmentalist* opts for 10 global challenges: air pollution, conflict, disease, global warming, hunger and malnutrition, lack of education, gender inequity, lack of water and sanitation, terrorism and trade barriers. Coming back to Kyoto Protocol, following the arguments of Dr. Lomberg, all its likely successors ought to be seriously concerned how to take the challenges on. Nuclear energies, nuclear efforts etc., should in no way take a back seat if the country like India has to acquire energy self-sufficiency. Millennium Development Goals (MDGs) have overlaps with challenges mentioned earlier. That this needs to be attended to through massive efforts has been looked by the author. Hopefully, the book will be great facilitator for leapfrogging to clean and cleaner technologies. While one can set forth a seemingly magnificently array of energy options because of pressing actionable features of the climate plan, in the ultimate analysis, we have too have a form of sustainable development that is stable from the economic standpoint, equitable because of social imperatives and above all, environmentally accountable. I commend this book to readers who are not bogged down to ironies of climate and climate change as well, but receptive to identifying capably strong strategies.

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Former Pro-Vice Chancellor, C.U.
Former Vice Chancellor, Vishva Bharati U.

Preface

India's great savant leader and national conscience-keeper Mahatma Gandhi had forewarned quite some time ago " the world has enough for everybody's needs, but not enough for everybody's greed." How a small sentence succinctly epitomizes a global truth. On one side, we have the high opulence, wasteful splurging of the affluent societies of the Western world juxtaposing the abject poverty and unmet hunger of vast humanities in Africa and much of Asia. This apparently unsustainable model has provoked the enunciation of the UN. The most important environmental challenges staring the earth are the unacceptably high pollution of the biosphere in the recent decades, manifested in many ways by the global warming, change of weather, unpredictable floods and draughts, shrinking biodiversity from deforestation and desertification, soil erosion affecting agriculture etc. After long and arduous research, investigation and deliberation at the national level and UN level, it has now been inferred that the pernicious global warming is due to high concentration of carbon dioxide and the other so-called Greenhouse gases (GHG) in the atmosphere. Excessive GHG emission has been caused by heavy consumption of fossil fuels (coal, oil, and gas). The high consumption of the fossil fuel has been ascribed to the abnormal energy-intensity of the current global technological-cum-industrial infrastructure.

Engineering the industrialized world thus throws another challenge. Admittedly, the modern life thrives on energy. When we drive a car on roads, rides on railways or fly in the sky, the motive engine consumes energy all the time. From the kitchen to the office and the factories, the modern civilization needs energy. Even after adjusting for the rationalization of consumption and increasing energy efficiency, it may not be feasible to much reduce the consumption of fossil fuel, albeit its high carbon-pollution. Then the fossil fuels are exhaustible resources of the earth and may not last even till the end of the 21st Century. The challenge of alternative energies is two-fold, to hit upon a carbon-neutral energy source immediately to replace or reduce the fossil fuel consumption and secondly to develop a large source of clean energy for the coming decades or centuries. The development trend is already visible towards renewable energy source of the earth—hydropower, wind power, and solar energy. As carbon-neutral energy source, nuclear energy is also finding large-scale revival. Hydrogen energy and Fuel cell technology are the incoming energy alternatives too, which are highly potential.

Greek philosopher Thales Miletus propounded "the best of everything is water". Down the ages, Leonardo da Vinci too reaffirmed water as the 'driver of nature'. Water is indeed the driver of life, the human body constituting 70 % of water. But because of its easy availability in the past, water has traditionally been regarded as the inexhaustible free gift of nature; this has led to extravagant and wasteful use; thus this life-saving resource has become scarce threatening human life, livelihood, agriculture, development and progress. A UN document (Mordel Plata Conference 1977) concluded that though potentially there may be enough water to meet the forthcoming global demands, there may be serious shortages of water at the right place, right time and right quality. The World Bank, the various UN agencies and the World Water Council have all published nearly similar world water maps showing more and more countries of the world will become water-stressed by 2050, because of its increasing scarcities. Thus there is a deep global challenge to plan, augment and rationalize demand and supply of water resources to carry the world forward in the 21st Century.

So much is the raison d'etre for the title of this book: *"Sustainable Development: Challenges of Environment, Energy and Water Resources"*. For each challenge, we have devoted a Part and there are Three Parts for the three major challenges and one introducing part on overview on Sustainable Development.

In Part I, we have first introduced concepts of sustainable development in Chapter 1.In the humanist-cum-environmentalist approach of the Brundtland Report, it connotes development that includes preservation of ecology and equity for all, that is inclusive development and growth. In the economist's parlance (Chapter 4), according to Robert Solow and others, sustainable development is to ensure inter-generational equity *i.e.,* natural resources shall be consumed keeping the long-term well-being and sustainability of the future generation in view. In case, the exhaustible natural resource must be used up faster, consumption must also lead to creation of capital stock for future generation in terms of technology and physical infrastructure. In Chapter 2, we have attempted a limited review and audit of various natural resources, which include agriculture, fisheries and aquaculture, wild life and forest resource and also just touched energy sources (Mongillo 2004). In Chapter 3, we developed the theme that application of science and technology for solutions to sustainability is essential. In Chapter 4, besides the subject of economic sustainability, we also submit that special governance model for sustainable development is necessary at the individual, corporate and the national levels (Lafferty 2001). Last but not the least, we should mention that we have included some aspects of the International Conventions including Earth Summit at Rio de Janeiro 1992 in Chapter 1. and UN Millennium Development and Goals in Chapter 2.

In Part II, we have presented an outline of the Challenges of Environment. The basic theme is that clean air which is vital for life is threatened by the general atmospheric pollution (Chapter 5) and automobile emission (Chapter 6). The categories of pollutants are principally carbon dioxide, carbon monoxide, sulphur dioxide, nitrous oxide and the SSP-10 (suspended solid particulates below 10 micron size). Solid particulates often give rise to smog acted upon by solar photolytic action. The more serious challenge comes from formation of large voids (known as Ozone Holes) in the upper atmosphere (stratosphere) allowing carcinogenous ultraviolet rays to pass through to the earth. Not so serious is the occurrence of acid rain (Chapter 8); the atmospheric Sox and Nox get hydrolyzed into their respective sulphuric and nitric acids and fall with the rain retarding or destroying the aquatic lives, plants and vegetation, buildings and other infrastructure. In the next three Chapters (9, 10 and 11), we break into the most burning issues of environmental challenges, firstly the increasing atmospheric concentrations of carbon dioxide, methane, nitrous oxide and chlorofluorocarbon, the so-called GHGs (glasshouse gases), and secondly, consequent global warming and climate change; all these may lead to glacial ice melting, unacceptable rise of sea level, drying up of rivers, erratic rainfall, floods and droughts. Such devastating challenges demand most urgent solutions.

In Part III on Energy, we have tried to present a long list of alternative energy options. Chapter 12 is really a preamble to the status of global stock of fossil energy, its global consumption and the pollution hazards thereof. In the subsequent seven chapters 13 to 19, we covered the availability and feasibility of several energy resources—nuclear energy, bio-energy (biomass, ethanol and bio-diesel), solar energy (thermal and Fuel Cells in Chapter 15, Wind Energy (Chapter 16), Hydrogen Energy & Fuel Cells (Chapter 17), Hydro-Energy (Chapter 18), and Geothermal, Wave Energy & Ocean Thermal Energy (Chapter 19). The obvious conclusion is there is still life and hope beyond the petroleum fossil fuel. The renewable Bio-fuels are able to bring down carbon emission substantially. But the other renewable solar and wind energies are totally carbon-neutral; so is the hydrogen-fed Fuel Cell, though there is possibility of carbon emission in producing hydrogen fuel. All these three forms of energy promise virtually limitless energy, provided continued research is devoted for upgrading their application technology and engineering.

The third dimension of our global challenge rest with development of water resources for the mankind, described in Part IV. There are two reviews, one carried out for global water resources (Chapter 20) and the other for the Indian water resources (Chapter 21 and 22). India, being of near continental size in land area and population, we have examined its rainfalls, rivers, river basins and potential inter-basin transference of water. Globally, total quantity of water available is more or less constant. The problems here are basically infrastructure development and water management, eliminating extravagance

and waste, economizing uses, treating water for quality and recycle water where supply falls short of demand.

Next, I like to identify the readers for whom this book is intended for. This book is not structured for any specific university courses but shall lend insights and identify milestones for Graduate students and Researchers working in the fields of environment, energy and sustainable development. It touches thoughts and provide numerous supporting data. However, despite the broad discourses in these subjects, the book makes occasional forays into some mathematical formulations, which the scientific readers may pursue, others may skip over. For a wider range of today's environmentally conscious public, the Part I of this book will indicate some guidelines of a socially equitable and responsible living and Part III (Energy) and Part IV (Water Resources) throw some enlightenment for the future.

In the call of social responsibility, I have now undertaken to write this book. In this task I have drawn heavily on the original work of many scientists, researchers, professors and social activists, to all of whom I am greatly indebted. Some of these sources I have acknowledged in the book and I regret, if I have missed to acknowledge many others. I shall be very gratified if the book is able to serve its objectives for the benefit of general public, researchers and students.

M.K. Ghosh Roy

Postscript

Copenhagen Accord 2009

In the process of publication of this book, the United Nations Framework Convention on Climate Change (UNFCCC) Conference took place at Copenhagen, 7–18 December 2009 which was attended by 192 Nations including the US. Let us hope that the Copenhagen Accord will usher in a new regime of equitable sustainable development through the instrumentality of mitigation and adaptation *vis-à-vis* global warming.

M.K. Ghosh Roy

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