

# Renewable Energy Resources and their Management



**Behl, Chhibar, Jain, Bahl, El Bassam**

# RENEWABLE ENERGY SOURCES AND THEIR APPLICATIONS

*Editors*

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**Prof. Ravindra (Ravi) Chibbar** obtained Ph.D. from University of Western Ontario, London, Ontario, Canada (1984) and earlier from PU, Chandigarh, India (1976). He joined the University of Saskatchewan, Canada in January 2004, as a Professor and Canada Research Chair in Crop Quality (Molecular Biology and Genetics). His main research interests are to employ molecular biological strategies/genomic tools to improve grain/seed quality, abiotic (low-temperature) stress tolerance and agronomic performance in cereal crops and grain legumes. He has identified quantitative trait locus (QTL) for pre-harvest sprouting resistance, low-temperature tolerance, several phenological traits under vernalized and non-vernalized conditions in wheat and beta-glucan

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**Prof. Surjeet jain obtained** B. Tech in Agriculture Engineering from Panjab Agriculture University, Ludhiana, India in 1974 and M.Tech. in Post Harvest Technology and Food Engineering from G.B. Pant University of Agriculture and Technology, Pantnagar, India in 1987. Prof. Jain, during his research and teaching carrier, specialized in seed conditioning, use of renewable energy in post harvest technology, food processing and was associated in the development of various machines and tools pertaining to food processing. He has taken advance training at Iowa State University, Ames, Iowa, USA under FAO-ICAR Fellowship. He has published several research papers in journals of repute, besides manuals and handouts in various fields of agricultural engineering. He also contributed chapters in books published in India. Prof. Jain formerly served as Head, Department of Food Processing, CCS HAU, Hisar and is now working as Director Principal of Manav Institute of Technology and Management, Jevra, Disst. Hisar (Haryana), India since 2010. He has coordinated several events of academic and practical interest.



**Prof. Ved Prakash Bahl**

**Prof. V.P. Bahl** started his professional career in the year 1972 soon after he graduated in B.Tech. (Agril. Engg) from Panjab Agricultural University, Ludhiana. He He worked in various positions in Haryana Agro Industrial Corporation, Tractor Training Centre (GOI) and CCS Haryana Agriculture University, Hisar, where he served for more than 33 years. As Professor and Head, Department of Farm Machinery and Power Engineering, he steered the department for teaching, research and extension activities with distinction. He excelled as a teacher, researcher and extension specialist and in recognition of his excellent contributions he was conferred Best Teacher Award by Haryana Agriculture University in 1984, Indian Society of Agriculture Engineering in 2000 and Bhaskar Group of News paper in 2012. Prof. Bahl has to his credit more than 150 publications in national and international journals and presented about 50 technical papers in national and international conferences. He has contributed in the organization of several national and international conferences.



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## **FOREWORD**

Adequate and affordable energy availability is essentially needed for all living beings in all walks of life. The major energy sources like coal, natural gas and petroleum products are non-renewable fossil fuels. These are finite and thus can be used only for a finite period. Also, emissions from non-renewable energy sources are major environmental pollutants.

Renewable energy sources, being eco-friendly and distributed globally, offer our planet a chance to reduce carbon emissions, clean the air, and serve as essential input for an overall strategy of sustainable development in agriculture, animal husbandry, industry, transportation, domestic uses such as water supply, sanitation, environmental quality, education etc. The major renewable energy sources include, solar, wind, hydro, geothermal, sea waves biomass and biofuels etc. In order to achieve the maximum utilization of renewable energy sources and supplies, the primary task, therefore, is to integrate the various forms of renewable energy.

In India various energy sources include Coal (48%), Natural gas (21%), Nuclear (20%), Hydro (6%), Solar, Wind and Biomass (3%) and other sources pooled together as only 2%. The average annual energy demand per capita in India is 631 kWh (~ 1.7 kwh/day) which is considerably lower as compared to developed countries in western hemisphere, the highest being for Canada followed by USA, Australia and the lowest being for Bangladesh.

India is acclaimed for its sunny areas as most of the country receives more than 4 kWh/m<sup>2</sup>/day with more than 300 sunny days per year in the most part of the country. Likewise India has a long sea coast areas and large plains where wind velocity for most part of the year remains high to enable production of wind energy. Globally largest cattle population in India makes it a huge bio-resource (cow dung) of bioenergy. Also, energy parks can be created by planting trees, shrubs in waste and marginal lands and even in deserts. Low lands can be used to produce energy from blue green algae etc. This calls for concerted efforts, political will, sound and pragmatic planning, appropriate technology for effective tapping of vast renewable energy sources in an integrated manner.

Manav Institute of Technology and Management, Jevra, Hisar organized an International Seminar on Renewable Energy for Institutes and Communities in Urban and Rural Settings from April 27-29, 2012. Scientists and policy planners from India and abroad participated and deliberated on various aspects of renewable energy including renewable energy sources, technology generation and refinement, domestic and commercial applications of renewable energy and needed policy interventions as support system etc.

This book entitled "**Renewable Energy Sources and Their Applications**" includes papers contributed by the participants and invited guests including scientists, policy planners, industry representatives and NGOs from India and abroad. This book is an excellent source of information on renewable energy and will be useful to researchers, development functionaries and policy makers. I congratulate the editors for bringing out this valuable and informative book for a systematic reading on renewable energy.



(M. L. Ranga)



**PROF. R.S. JAGLAN**

## Application of Renewable Energy Options for Environmental Sustainability- Vision

**Prof. R.S. Jaglan**

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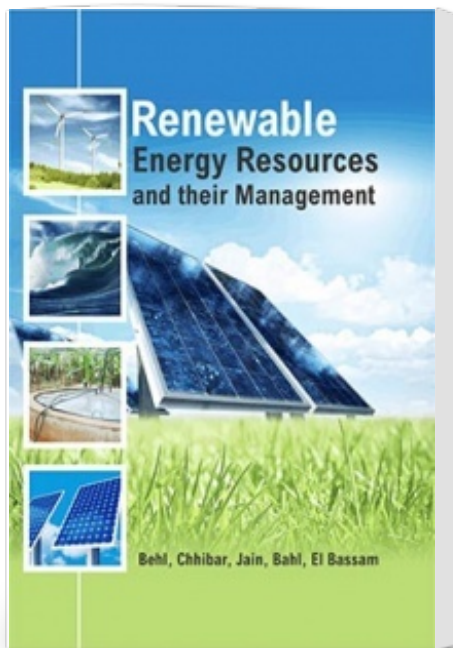
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Global climate change is a matter of concern both within the scientific community and in policy-making circles. Ways and means and available options for mitigating global climate change provide even more fertile ground for intensive debate. A number of countries have prepared contingent plans for addressing the global climate change question at national level however; international cooperation on appropriate and equitable measures for mitigating climate change needs further strengthening.

Fossil fuel reserves are continuously depleting. Also these are potentially major sources of harmful local and global emissions and tend to be concentrated in a few countries. On the other hand, renewable sources of energy are not only environmentally-benign but are better distributed globally. Existing estimates of energy use in Indian states and other developing countries indicate a significant and persistent dependence on traditional energy technologies including coal, gas, cattle dung and biomass based ones and limited use of modern renewable energy technologies. Focus on a collective wisdom of various stake holders is needed to identify ways and means as well as policy interventions required to promote the use of renewable energy technologies and invent appropriate technologies for urban and rural settings.

Institutes like Manav Institute of Technology and Management at Jevra can serve as a hub for the industry's prominent networking event for inventors/developers, producers/manufacturers, suppliers, large and small energy consumers, investors and lenders, institutions, municipalities, and governments. The management of Manav Institute and whole team of the organizing committee deserve applause for organizing an international event on renewable energy to identify needed research, development and policy issues and generate a consensus for the use of renewable energy in our daily life. More such international events would interest researchers, research scholars, technology students, manufacturers, development functionaries, policy planners, financial institution, suppliers and government as well as non government institutions. Therefore, concerted efforts are warranted to develop international linkages to strengthen research and development for continuous enhancement in precision of the technology for sustained efficiencies.

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