

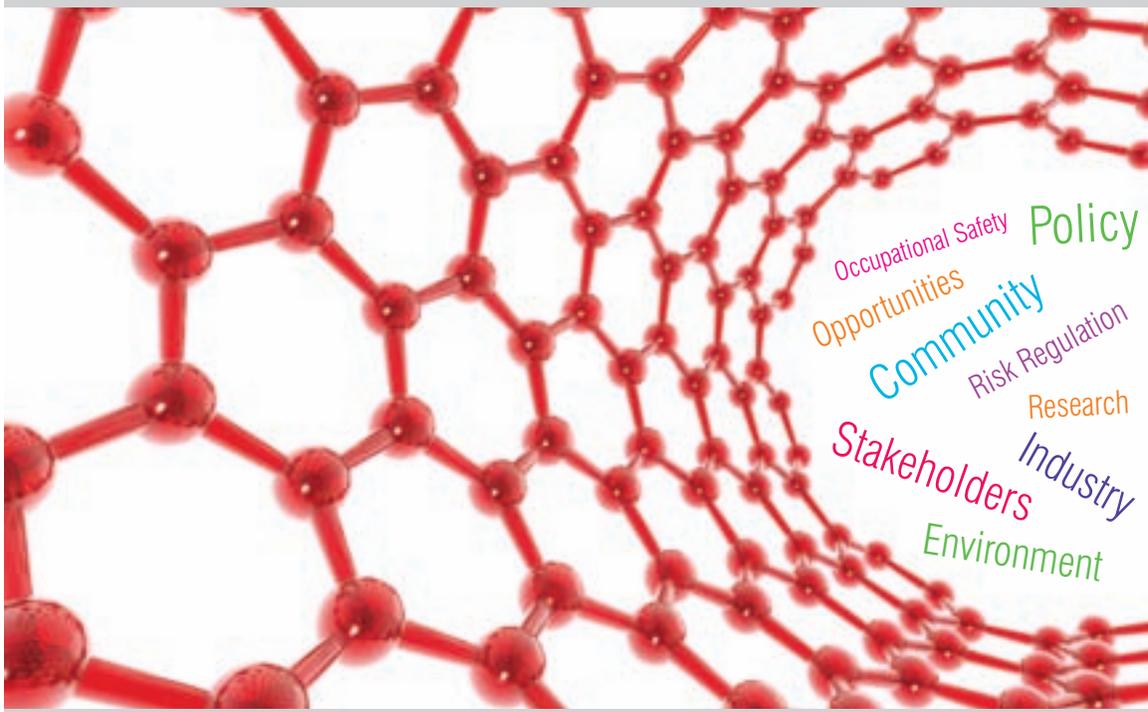
# Capabilities and Governance of Nanotechnology in the Developing World

## Insights from India

### Editors

Shilpanjali Deshpande Sarma

Manish Anand



The Energy and Resources Institute

Capabilities and Governance  
of Nanotechnology in the  
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The research presented in this publication was carried out with the financial assistance of Canada's International Development Research Centre.

**Published by**

|   |               |                          |
|---|---------------|--------------------------|
| The Energy and Resources Institute (TERI) | <b>Tel.</b>   | 2468 2100 or 4150 4900   |
| TERI Press                                | <b>Fax</b>    | 2468 2144 or 2468 2145   |
| Darbari Seth Block                        |               | India +91 • Delhi (0) 11 |
| IHC Complex, Lodhi Road                   | <b>E-mail</b> | teripress@teri.res.in    |
| New Delhi – 110 003                       | <b>Web</b>    | www.teriin.org           |

Printed in India

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# Foreword

I have had a long association with the Indian nanoscience and technology scene. It is the feeling of the scientific community that India had missed the semiconductor/superconductivity revolution years ago by not taking initiatives and making investments at the right time and so this time around they did not want to miss the bus in relation to nanoscience and technology. That led to the Indian blueprint on the Nano Initiative and subsequently the Nano Science and Technology Mission, of which I was the Mission Director, while working at the Department of Science and Technology as the Head of the Science and Engineering Research Council. India is now witnessing the transition from its capacity-building initiatives in the nanotechnology domain towards the next phase in which a vigorous expansion and advancement in the field is anticipated.

In light of these developments, this publication, *Capabilities and Governance of Nanotechnology in the Developing World: Insights from India*, comes at a very opportune moment for India and probably other developing nations since it lays emphasis on responsible innovation in nanotechnology. For the nanotechnology community in India that is gearing towards the development of concrete applications while anticipating an appropriate regulatory framework and also for other developing nations building on their nanotechnology endeavours, this book could probably clarify the many issues that must be straddled for sustainable and effective outcomes from engaging with nanotechnology. I believe this book is important from the point of view of understanding the social determinants of nanotechnology. It brings forward splendidly the need in this country for scientists and social scientists to work together, if emerging areas like these have to do good to the nation as whole. I have rarely come across a publication which brings together these multidimensional elements in a high technology area, such as this one. Of course, the reader can be the judge of this from his or her own perspective.

I was fortunate to have been associated with the TERI team in its efforts towards this intellectual exercise. This publication is an outcome of half a decade of creative and diligent efforts by researchers at TERI that took the shape of intensive studies, reviews, and wide-ranging stakeholder interactions on diverse issues through dialogues, interviews, and surveys. A particularly interesting exercise was their dialogue in January 2010 on risk governance issues which was attended by scientists, technology developers, risk researchers, and social scientists. The dialogue led to several interesting arguments being placed by the concerned stakeholders. My involvement in such occasions and overall experience has been towards contributing to a balance between technological issues and its implications, particularly in the area of risk management and others of an ethical nature. This book is therefore an outcome of interdisciplinary research efforts and inclusive perspectives, making it a unique literary endeavour.

The book addresses a range of aspects that are extremely relevant to the progress of nanotechnology in the world today. Alongside an appropriate focus on technological benefits, advancements, and national innovation capacities, the authors have also sought to outline issues that societies currently grapple with in relation to responsible development of nanotechnology — environmental, socio-economic, and ethical impacts as well as the accompanying regulatory and governance challenges. The authors offer keen insights for policy and effective multi-level governance of nanotechnology. The book is thus a comprehensive and thought-provoking resource for the curious reader as well as the experienced nanotechnology practitioner or researcher. It offers an informed view of the multiple facets and implications of this revolutionary technology and makes an effective case in favour of the need for multi-layered capacities being developed for responsible innovation. It certainly advances the discourse on nanotechnology and developing societies and will help inform policy-makers and other stakeholders on a wide range of issues.

The issues raised in the book are simple yet profound. While these have been with us for a very long time, they have acquired significance and urgency in the wake of twentieth-century scientific revolutions. Many of these issues and questions have no clear answers as yet, but that should not deter us from asking and trying to find these elusive answers. The book assembled here addresses questions of the sort that all of us ask as children of science and many of us fortunately do not cease to ask as adults. To quote Isaac Newton:

I do not know what I may seem to the world, but as to myself, I seem to have been only like a boy playing on sea shore, and diverting myself now and then finding a smoother pebble, or a prettier shell than ordinary, whilst the great ocean of truth lay undiscovered before me.

To me this book has revealed new and interesting issues that every student of science should be seriously concerned with.

The TERI team deserves credit for having brought these intricate issues out into open. It is my sincere appeal to all sections of the scientific community to address these concerns while at the same time trying to advance technological developments.

It is a pleasure to have worked with the TERI team. As I have said earlier, the team had a stupendous task of gathering and integrating the multitude of issues related to emerging technologies, such as nanotechnology. I wish to extend my appreciation and best wishes to the TERI team for their hard work and excellent contribution to the field of nanotechnology.

December 2013

**Venkatesh Rao Aiyagari**

Former Mission Director

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Department of Science and Technology, New Delhi

# Acknowledgements

This publication draws on the work conducted over five years by the authors involved in two research studies supported by the International Development Research Centre (IDRC), namely, 'Capability, Governance, and Nanotechnology Developments: A Focus on India' and 'Nanotechnology in South Asia: Building Capacity and Governing the Technology'. The compilation of this book has benefited immensely from interactions with a large number of people. The authors would like to take this opportunity to thank them all.

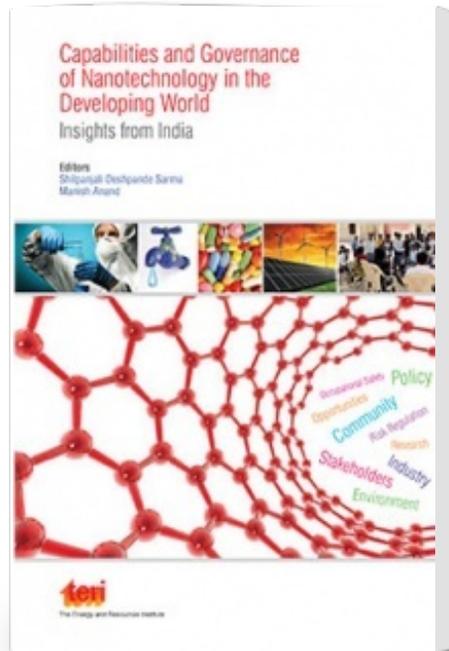
First and foremost, the authors gratefully acknowledge IDRC for its support over the years, enabling enhanced research capacities on emerging technologies and policy issues. In particular, the authors wish to thank Stephen McGurk, Veena Ravichandran, Ritu Kalia, Sara Ahmed, Margaret Male, and Prabha Sethuraman for their constant encouragement and help.

During the course of the project and in the efforts to build capacities in the complex area of nanotechnology policy and governance issues, the team has gained much from the advisors to the project as well as from interactions with stakeholders. Their insights were invaluable and the authors would like to extend their heartfelt thanks to them. The authors especially thank the Project Leader, Ligia Noronha, for all her contributions, indispensable guidance, and support throughout the project duration. The extended advisory group in TERI also provided much intellectual encouragement in the design and development of this study and the authors express their gratitude to Prodipto Ghosh, S Sundar, and Suresh Babu. We also thank our external advisors Veena Chhotray and Venkatesh Rao Aiyagari for their guidance.

The authors acknowledge the research contributions of project team members — Seema Singh, Jayashree Vivekanandan, and Saswata Chaudhury.

Throughout the process of writing this book, many individuals from the community have taken time out to help the team. Special thanks is due to the reviewers, YP Abbi, Prajit Basu, Sujit Bhattacharya, Arunava Goswami, Nilanjan Ghosh, and Shyama V Ramani for their feedback. This publication has benefited from their inputs and the authors gratefully acknowledge their support and guidance.

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Publisher : TERI Press

ISBN : 9788179935675

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Type the URL : <http://www.kopykitab.com/product/6134>



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