

India's Developmental Strategy under the Low-Carbon Economy

Vandana Sharma¹, Smita Chaudhry²

^{1,2}Institute of Environmental Studies, Kurukshetra University, Kurukshetra, India

Abstract: India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. In order to cope with the climate change and to promote India's economic growth and the energy security, low carbon economy should be adopted. A country's energy policy will be immediately impacted by a transition towards a low carbon economy. The Government of India is implementing increasingly wide-reaching regulations and incentives to reduce emissions and is preparing adaptation plans and has planned reductions in carbon intensity of its economy by launching various energy efficiency related policies and measures, National Action Plan on Climate Change, REDD+, carbon finance etc. The government is putting in place incentives, fiscal measures and preferential arrangements such as feed-in-tariffs to attract investors and enable projects to be commercially viable. Low carbon development shall take place in the context of sustainable development, in which the priority is to build up resource-efficient and environment-friendly society, as well as innovation-driven nation. A focused approach of policy and reducing bottlenecks in emerging business scenario can go a long way in enabling a Low Carbon Economy.

Keywords: Low Carbon Economy, Energy Efficiency, Government of India, REDD+, GHG, Emissions.

1. India's concern about the GHG emission

India is in a rapid process of industrialization and urbanization; hence the total amount and the rate of the GHG emission has recently increased tremendously, also the population of India is 1.21 billion approximately representing 17.5% of the world population [1]. The total net Greenhouse Gas (GHG) emissions from India in 2007 were 1727.71 million tons of CO₂ equivalent (eq) of which GHG emissions from Energy, Industry, Agriculture, and Waste sectors constituted 58%, 22%, 17% and 3% of the net CO₂ eq emissions respectively. Energy sector emitted 1100.06 million tons of CO₂ and the total CO₂ equivalent emission from industry sector was 412.55 million tons in 2007. In terms of CO₂, the per capita emission was 1.3 tons CO₂ per capita or 0.35 tons of C per capita. In comparison, in 1994, the population was 897 million, comprising 15.8% of world population [2]. The per capita GHG emissions in 1994 were accordingly 1.4 t CO₂ eq/ capita, 0.9 tons CO₂/ capita or 0.24 tons C/capita. India ranks 5th in aggregate GHG emissions in the world, behind USA, China, EU and Russia [2].

Climate change is recognized both as a threat and a challenge. The impact of human activities on climate and climate systems is unequivocal. Climate has a significant role in the economic development of India. Many sectors of the economy are climate sensitive. Developing countries particularly India are at risk, as its infrastructures are most vulnerable to extreme events, and there is an expectation that climate change will worsen their food security, water availability and health, in addition to accelerating biodiversity losses [3]. India is a developing country that perfectly illustrates the nature of this challenge involved in developing its economy whilst also preventing dangerous climate change. India is currently in a major predicament. Its development goal to bring a considerable portion of its population out of poverty is currently being undermined by the vulnerability to climate change. India's economy is growing at the rate of about 9% per annum, while emitting

significant amounts of greenhouse gases (GHGs) from fossil fuel use. The International Energy Agency (IEA) predicts that India will be among the top three emitters of the world by 2030 [4]. Therefore, India is a priority target for CO₂ reduction [5]. A rapid transition towards a low-carbon economy is essential to address the climate change challenge. The International Energy Agency's (IEA) [6], highlights the unprecedented scale and pace of change required to mitigate the most damaging impacts of climate change. Scientific evidence has confirmed this as a necessity and economic analysis has shown this to be possible [7]. However, almost half of India's households (56%) do not have electricity, and women and girls spend a total of 80 billion hours each year collecting firewood [8]. In order to cope with the climate change and to promote India's economic growth and the energy security, low carbon economy should be adopted.

2. Challenges in Low Carbon Development

India emits nearly 5% of global CO₂ emissions, and emissions continue to grow. CO₂ emissions have more than doubled between 1990 and 2008 [9]. The WEO 2009 Reference Scenario projects that CO₂ emissions in India will increase by more than 2.5 times by 2030 from 2008. Economic growth, energy supply, thermal electricity generation and national CO₂ emissions have profound linkages in India. During 1990–2005, the Indian gross domestic product (GDP) has grown by 148% [10–11], commercial energy supply by 118%, thermal electricity generation by 170% [11]–[12] and total CO₂ emissions by 100% [13]. Economic growth of India has evidently remained strongly coupled with CO₂ emissions. The Government of India has targeted GDP growth implying a rapid growth in CO₂ emissions from India.

2.1 Challenges from the Growing Population

India is the second most populous country in the world, with over 1.21 billion people [1] (Figure: 1), more than a sixth of

the world's population. Already containing 17.5% of the world's population, India is projected to be the world's most populous country by 2025, surpassing China, its population exceeding 1.6 billion people by 2050. However, its population growth rate is only 1.41%, ranking 93rd in the world [14].

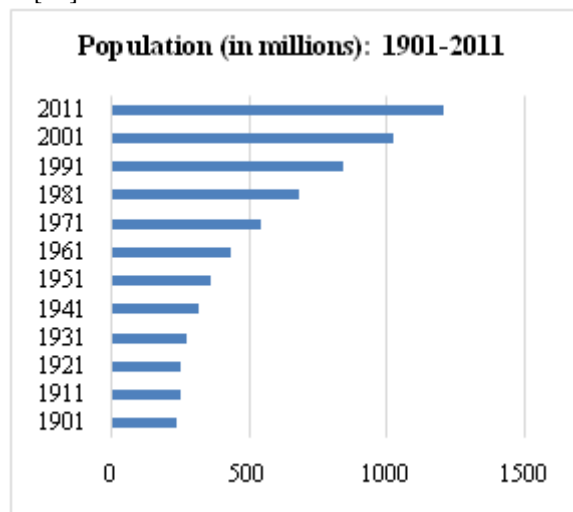


Figure 1: Growth in population since 1901 [1].

Rapid population growth, developmental activities either to meet the growing population or the growing needs of the population as well as changing lifestyles and consumption patterns pose major challenge to preservation and promotion of ecological balance in the country.

2.2 Total Primary Energy Supply & Coal Dominance in Energy consumption

In 2005 CO₂ emissions in India were 1229 Mt CO₂, and almost doubled during 1990–2005 [13]. A significant fraction of the CO₂ emanating from fossil-fuel combustion and specific industrial activities was emitted by large point sources (LPSs), with thermal power, steel, cement, fertilizer, petrochemical, aluminum plants, gas processing, and petroleum refineries contributing over 70% of all-India CO₂ emissions in 2005. Coal contributed 72% of all-India CO₂ emissions, overwhelmingly from power and steel plants. The top three sectoral contributors were power plants (51.9%), steel plants (8.4%) and cement plants (8%). The twenty-five largest emitters contributed 34% of the total all-India CO₂ emissions in 2005 and have grown around 10% per annum during 1990–2005 [15].

2.3 Poor Energy efficiency investments

Greater energy efficiency is key for shifting country development paths toward lower-carbon economic growth. Improving the efficiency of energy use is a leading option to gain better energy security, improve industry profitability and competitiveness, and reduce the overall energy sector impacts on climate change. But the reasons for not adopting energy-efficient technologies in India include energy pricing policies (e.g., low electricity prices for households and agriculture), other government policies (e.g., tariffs), high start-up costs, scarce opportunities for funding investments, uncertainties about the benefits of investments, and lack of information and awareness [16]–[21].

3. What is Low Carbon Economy

Low-carbon economy refers to an economy that has a minimal output of GHG into the biosphere, namely, an economical model based on small energy consumption, low environmental pollution, low-carbon emission, and is the important progress of human being after agricultural and industrial civilization. The nature of low-carbon economy is to utilize energy efficiently and to exploit clean energy, seeking green GDP, the critical problems involved in the technological innovation of energy, emission reduction, changes of industrial structure and people's conceptions. Green GDP is an index of economic growth which deducts the cost of environmental damage and resources consumption from the traditional gross domestic product [22].

A Low-Carbon Economy (LCE) is an economy that adopts the Low Carbon Growth path and minimizes the release of greenhouse gases (GHG) without compromising on the development objectives of the Country [23]. "Low carbon development" and "climate change mitigation" are generic terms to indicate the transition towards development options that reduce human interference with the climate system. This means reducing the release of greenhouse gases into the atmosphere from chemicals and fossil fuels. It also includes emission reductions from changes in land use, such as deforestation and more energy intensive methods of agriculture [24].

Developing low-carbon economy in India is compatible with Indian characteristics, and it is indispensable for India's sustainable and scientific development. Therefore, the core energy developing strategy of India is to develop low-carbon energy and utilize fossil fuel clearly and efficiently. The Stern Report on the Economics of Climate Change, highlighted the fact that if the global community doesn't act now, the overall costs and risk of climate change are enormous- the equivalent of losing at least 5% of the global GDP each year, now and forever [25]. India is one of the countries predicted to be most exposed to climate change impacts. Temperature rise of 2°C and beyond will have major consequences for human health, food production, water availability and ecosystems. Human settlements and economic activity in coastal regions are at the highest risk. It is estimated that in India up to 3% of GDP is already spent annually responding to the adverse impacts of a changing climate.

4. Indian Government's Proactive Domestic Measures for Enabling Low Carbon Development

Being one of the fastest growing economies in the world, India faces both the challenge of the need for rapid growth, as well as the escalating GHG emissions. Acknowledging the importance of vigorous domestic actions in combating climate change and driving global policy, the Government of India has initiated numerous initiatives to lead the way towards low-carbon growth. The Government of India has committed itself to making India a 'low carbon' economy. It has recently announced voluntary and unilateral targets to

reduce the emissions intensity of its GDP[26]. The Ministry of Environment & Forests sums up the essence of policy making required to address climate change in the form of the “3M’s” – Measurement, Modelling and Monitoring [27]. Some of the key domestic policy imperatives that have been introduced in India are detailed below.

4.1 National Action Plan on Climate Change (NAPCC)

On 30 June 2008 the Indian Government announced the National Action Plan on Climate Change (NAPCC). The Government of India has planned reductions in carbon intensity of its economy by launching the NAPCC. The plan identifies eight core “national missions” running through to 2017 (Table 1).

Table 1: NAPCC eight core national missions

<i>Mission</i>	<i>Objective</i>	<i>Responsible Entity</i>
National Solar Mission	20,000 MW of solar power by 2020	Ministry of New and Renewable Power
National Mission on Enhanced Energy Efficiency	10,000 MW of EE savings by 2020	Ministry of Power
National Mission for Sustainable Habitat	EE in residential and commercial buildings, public transport and solid waste management	Ministry of Urban Development
National Water Mission	Water conservation and river basin management	Ministry of Water Resources
National Mission for Sustaining the Himalayan Ecosystem	Conservation and adaptation practices, glacial monitoring	Ministry of Science and Technology
National Mission for a Green India	6 million hectares of afforestation over degraded forest lands by the end of 12th plan	Ministry of Environment and Forests
National Mission for Sustainable Agriculture	Drought proofing, risk management, agricultural research	Ministry of Agriculture
National Mission on Strategic Knowledge for Climate Change	Vulnerability assessment, research observation, data management	Ministry of Science and Technology

The plan “identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively.” It notes that these national measures will be more successful with assistance from developed countries, and pledges that India’s per capita emissions will at no point exceed that of developed countries even as India pursues its development objectives. Under the NAPCC, several initiatives have been planned which will propel low carbon investments in India as well as better management of water, natural habitats and human settlements[24]. In addition to the eight national missions, 24 other ‘Critical Initiatives’ are on the anvil to address climate change in a holistic manner, for which detailed plans and institutional framework is being planned.

Thus, as an emerging economy, India’s NAPCC does not focus on or stipulate emission reduction targets. Instead it emphasizes on long-term mitigation strategies while promoting growth and inclusive development with

“sustainable co-benefits”. Through sectoral mission documents the NAPCC provides a detailed road map for achieving this. Intervention areas include renewable energy, energy efficiency, waste management, public transport, water management, afforestation, agricultural resilience while emphasizing inclusive and sustainable development, especially for poorer sections of the society.

4.2 Indian Network of Climate Change Assessment (INCCA)

The knowledge and understanding of implications of climate change at the national level is inadequate and fragmentary. The Ministry for Environment and Forests, on October 14, 2009 announced the launch of the Indian Network for Climate Change Assessment (INCCA), is a network comprising 127 research institutions which has been conceptualized as a Network-based Scientific Programme designed to:

- Assess the drivers and implications of climate change through scientific research
- Prepare climate change assessments once every two years (GHG estimations and impacts of climate change, associated vulnerabilities and adaptation)
- Develop decision support systems
- Build capacity towards management of climate change related risks and opportunities [28].

4.3 Expert Group on a Low Carbon Strategy and Inclusive Growth

A number of studies on low carbon growth have been undertaken by various organizations, and several initiatives in different sectors are already underway or are being planned. However, there is a need for a coherent view of potential options to be taken, and a mutually consistent strategy to be evolved to give the overall goal of low carbon development a concrete shape. With the above objective, an expert group was constituted by the Planning Commission to develop a low carbon inclusive growth strategy for India’s Twelfth Five Year Plan. This Expert Group on Low Carbon Strategies for Inclusive Growth in its interim report estimated the national emissions reduction potential by 2020 for various sectors under two scenarios namely 8% and 9% annual GDP growth. The sectors covered were power sector, transport, iron & steel, cement, oil & gas, buildings, waste management, other industries and households. The Expert Group has either not considered or considered very limited potential in the following sectors: energy distribution, chemical industries, fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride, construction, solvent use, mining/mineral production and fugitive emissions from fuels (solid, oil and gas) [29].

4.4 Carbon Tax on Coal to Fund Clean Energy

A clean energy tax on coal, at the rate of Rs. 50 (~US\$1) per tonne, will apply to both domestically produced and imported coal. The expected earnings from this tax are around US\$500 million for the financial year 2010- 2011. The government plans to channel these into a National Clean Energy Fund that will be used to fund research, innovative projects in clean energy technologies, and environmental

remedial actions[27]. An inter-ministerial group (IMG) was formed in 2011 to approve the projects/schemes eligible for the fund. Any project/scheme for innovative methods to adopt to clean energy technology and research & development shall be eligible for funding under the NCEF. The projects fields eligible are: solar, wind, tidal, geothermal, silicon manufacturing, coal gasification, coal bed methane, shale oil, hydrogen/fuel cells, hybrid vehicles, advanced computing, nuclear technology and NAPCC projects etc.

4.5 Enhanced energy efficiency related policies and programmes

Various energy efficiency related policies and measures are in force to deliver the priority missions related to energy efficiency and renewable energy such as:

- Energy Conservation (EC) Act 2001.
- Making the EC Act operational, by strengthening the institutional capacity of State Designated Agencies (SDAs).
- Perform, Achieve and Trade (PAT): India has embarked on one of the most ambitious and extensive energy saving initiatives in its history, when the much-anticipated Perform, Achieve, Trade (PAT) scheme becomes operational. The PAT scheme is a trading mechanism designed for high energy consuming industries. It aims to incentivize industrial sectors and units to implement energy efficiency measures and to comply with energy consumption targets set by the regulator (Bureau of Energy Efficiency (BEE)). Experts estimate that if PAT is successful, it alone could help India meet half of its emissions intensity targets announced at Copenhagen, i.e. a reduction of 20-25% reduction by 2020, based on a 2005 baseline. The PAT scheme is a market-based mechanism to enhance energy efficiency in the 'Designated Consumers' (large energy-intensive industries and facilities - power, cement, fertilizer, aluminium, iron and steel, railways, pulp and paper and textiles). The resulting savings can be traded as Energy Savings Certificates (ESCs).
- Market Transformation for Energy Efficiency (MTEE): Making energy-efficient products more affordable and mandatory in some designated sectors (mainly industrial). This target is to be achieved by Demand Side Management (DSM) measures, supported by carbon finance - CDM financing wherever possible. The initiative includes the following activities:
 - a. Programme-based (programmatic) CDM
 - b. Standards and labeling: The National Energy labeling program was launched in May 2006. This scheme attempts to curb demand at the consumption level, by mandating certain norms for appliance manufacturers. The standards provide a minimum energy efficiency standard that is depicted by number of stars on each appliance. The range of star rating is from one to five. A five star marked appliance implies the most energy efficient appliance. This program helps consumers make an informed purchase. At present this program is mandatory for the following appliances: frost free refrigerator, distribution transformer, tube fluorescent lamp and air conditioner.

- c. The Energy Conservation Building Code (ECBC): This code was launched by Ministry of Power (MoP) in 2007 as a voluntary scheme to optimize energy use across commercial buildings.
- d. Public Procurement: The Bureau of Energy Efficiency (BEE) has issued a memorandum for promoting procurement of energy efficient appliances in all ministries/departments and their attached subordinate offices.

Bachat Lamp Yojana (BLY): The BLY scheme promotes usage of energy efficient bulbs to reduce consumption load at the domestic level and promotes replacement of inefficient bulbs with compact fluorescent lamps (CFLs) by leveraging the sale of Certified Emission Reductions (CERs) under the Clean Development Mechanism (CDM) of the Kyoto Protocol. The scheme provides a unique platform for a robust public-private partnership between the Government of India, private sector CFL suppliers and state level electricity distribution companies (DISCOMs). The scheme provides a framework to distribute high quality CFLs at a subsidized price to the residential households in exchange for an incandescent lamp (ICL). BLY has also accrued CERs through the Programme of Activities (PoA). India has the highest number of projects registered with the UNFCCC under BLY PoA.

4.6 Renewable energy related policies and measures

India has abundant potential of variety of renewable energy (RE) sources. However, all the States are not endowed with the same uniform level; some States have a very high RE potential, while other States have very little. The government is putting in place incentives, fiscal measures and preferential arrangements such as feed-in-tariffs to attract investors and enable projects to be commercially viable[24].

- Electricity Act (EA) 2003: Requirement for states to set RE targets
- National Electricity Policy (NEP) 2005
- Industrial policy for renewable energy
- Foreign investment policy for renewable energy
- Solar Cities program in India
- Financial incentives for investing in renewable energy technologies
- Feed-in tariffs

4.7 Reducing Emissions from Deforestation and Forest Degradation (REDD+)

India is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Government of India attaches great importance to climate change issues. In accordance with the Cancun Agreements, developing countries willing to undertake REDD+ activities are required to formulate and follow a national strategy or action plan, establish a national forest reference emission level or national forest reference level or, a subnational level as an interim measure, a robust and transparent national forest monitoring system for the measurement, reporting and verification (MRV) on the performance of the REDD+ activities, and a system for providing information on how the REDD+ safeguards are being addressed and respected. Since India is willing to implement REDD+ mechanisms, these

stipulations are equally valid for it. India actively participated and took lead in international negotiations leading to REDD+ agreements. India is fully committed to implementing REDD+ activities, and therefore, also to develop a REDD+ strategy to be implemented in accordance with the UNFCCC agreements in its forest sector. [30]. It has presented an ambitious Green India Mission programme under its National Action Plan on Climate Change [31]. India is underlying the following initiatives related to REDD+.

- India has made a submission to UNFCCC on “REDD, Sustainable Management of Forest (SMF) and Afforestation and Reforestation (A&R)” in December 2008
- A Technical Group has been set up to develop methodologies and procedures to assess and monitor contribution of REDD+ actions
- A National REDD+ Coordinating Agency is being established
- A REDD+ cell has been established in the Ministry of Environment and Forests (MoEF) and the Forest Survey of India (FSI) has been entrusted to conduct the task for forest carbon stock accounting. The REDD+ cell would be assisted by Indian Council of Forestry Research and Education (ICFRE), Indian Institute of Remote Sensing (IIRS), Indian Institute of Science (IISc), Wildlife Institute of India (WII) and the state forest departments.
- A Reference document is prepared by Ministry of Environment and Forests to facilitate REDD+ implementation in the country, which clearly indicates Government of India commitment to optimally explore the mitigation potential of forestry sector in the country.

As per India's submission on REDD+ to UNFCCC, India's national strategy aims to enhance and improve the forest and tree cover across the country, while enhancing the value of forest products to the communities dependent on the forests for livelihoods and other services. The Green India mission under the NAPCC and the National Afforestation Program would aid in achieving this goal. India has submitted that this would require an investment of USD 2 billion every year for 10 years. India would also aim to have maximum participation from the communities in the REDD+ programmes and follow the successful model for Joint Forest Management. The pilot projects under REDD+ would be launched upon availability of funding [29]. India is fully committed to implementing REDD+ activities whose primary objective is to minimize the carbon emission and enhance their carbon storage capacities through sustainable management programme [32].

4.8 India GHG program

On 22 July 2013, WRI India, TERI and CII launched the India Greenhouse Gas Program (India GHG Program), a voluntary initiative to standardize measurement and management of GHG emissions in India. The WRI's India GHG Program aims to help companies in India to monitor their progress towards voluntary reduction goals in a consistent and credible manner. The program will provide companies with tools and technical assistance to build inventories, identify reduction opportunities, establish both annual and long-term reduction goals, and track their

progress based on the GHG Protocol, the most widely used emissions accounting and reporting standard in the world.

4.9 National communication (UNFCCC reporting)

The United Nations Framework Convention on Climate Change (UNFCCC) has laid down a mandatory reporting exercise to all countries party to the Convention. In accordance with the principle of 'common but differentiated responsibilities' enshrined in the Convention, each non-Annex I country Party have to submit its initial communication to the Convention. As per the Convention's requirement, India submitted the first initial national communication (NATCOM-1: reporting GHG inventory for the year 1994) in the year 2004 and the second national communication (NATCOM-2: reporting GHG inventory for the year 2000) was submitted in 2012. The national communication covers issues like the national circumstances in terms of the national GDP, geography, population, literacy, economic state energy demand, GHG inventory information, vulnerability assessment and adaptation, research and systematic observation, education and capacity building and programs on sustainable development. It highlights the gaps and shortcomings which create a barrier for financial and technical capacity to address the impacts of climate change.

4.10 Carbon Finance

India is a party to the United Nations Framework Convention for Climate Change (UNFCCC) and so Clean Development Mechanism (CDM) projects can be implemented in India and the resulting Certified Emissions Reductions (CERs) can be traded globally. The availability of these tradable CERs increases the attractiveness and viability of projects for investors [24]. India's participation in the carbon markets has contributed to the recognition that it is a useful tool in attracting climate friendly investments. India was an early player in the market, and it used the hosting of the Eighth Conference of Parties to the UNFCCC in Delhi in October 2002 to sensitize the business community about the opportunity provided by carbon finance and the modalities of the emerging CDM [33]. The CDM's primary goal of supporting development whilst creating cost-effective greenhouse gas emissions reduction is achieved through the buying and selling of CER credits [24]. As a developing country, India does not have any emission reduction target, but it is able to sell CERs pursuant to the CDM, to large emitters covered by the EU ETS, countries that have emission reduction targets under the Kyoto Protocol, or any other entity that wishes to purchase such CERs for compliance purposes. It can also supply ERs and VERs for the growing voluntary markets [33].

By May 2013, the NCDMA had approved about 2,800 projects of which 40% are registered with UNFCCC, 25% are at the stage of validation with UNFCCC accredited Designated Operational Entities, 10% have completed validation and are now with UNFCCC for final approval / registration and 25% have either been withdrawn by the project proponents, the validation has been terminated by DOE or have been rejected by the CDM regulators at UNFCCC. The registered CDM projects and NCDMA

approved projects from India represent an investment of over INR 1.6 trillion and INR 5.5 trillion respectively[29].

5. Conclusion

For India, the only way to deal with the sharp conflict between rapid economic growth and high CO₂ emission is to develop a low carbon economy, including technological innovation, developing low-carbon energy technology, transforming economic growth patterns and social consuming model. Designing an appropriate mix of policy instruments, and implementation of low carbon strategies, is a task that is highly multi-sectoral and inter-disciplinary in nature. Collaboration and open stakeholder involvement from a range of fields including government, industry, academic and civil society is essential in carving out the details of the path ahead in order to ensure that the best policies are implemented to promote environmental sustainability, spur innovative businesses and meet the poverty reduction and basic access needs of India's large underserved population. However, the path to low carbon economy in India has its own set of challenges. India should recognize the importance of technological innovations in implementing low carbon growth strategies and harness research and development in that direction. A focused approach of policy and reducing bottlenecks in emerging business scenario can go a long way in enabling a Low Carbon Economy.

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Author Profile

Vandana Sharma is a Research Scholar at Institute of Environmental Studies, Kurukshetra University, Kurukshetra, India. She received the M.Sc. degree in Environmental Sciences from the same department. She is currently working as Assistant Professor in College of Vocational Studies, University of Delhi, New Delhi. She has earlier worked with National and International Organizations like GIZ, Ministry of Environment and Forests etc.

Prof. Smita Chaudhry is Director, Institute of Environmental Studies, Kurukshetra University, Kurukshetra, India. She received her Ph.D. degree in 1991 (Ecology, Kumaun University, Nainital) and M.Sc. in 1984 (Botany, Kumaun University, Nainital). Her specializations are in Plant Ecology, Ecological Restoration and Environmental Biotechnology. She has 25 years of research & teaching experience.