Abstract

This thesis undertakes an integrated analysis of energy, environment and economic development, uncovering some of the dynamics of the inter-linkages amongst them. The analytical treatment is focussed on the Indian economy with various aspects of its economic development and several leading energy and environmental indicators quantified to the extent possible. In particular, the focus of the thesis is on energy resources such as coal, oil and electricity, environmental problems such carbon dioxide emissions (a suspected precursor of global climate change), deforestation, and pollution of environmental media (air, water and land).

Mathematical models are the chief analytical tools in this thesis. Three different types of models of resource allocation and consumption are developed in this thesis to analyse different aspects of the problem at different levels. Input-Output (I-O) models provide a relatively static analysis of energy consumption and carbon dioxide emission patterns. Activity analysis-based economy-wide dynamic optimization model looks into the issues of carbon dioxide emission restrictions at the national level, and also the nexus between poverty and deforestation. Finally, activity analysis-based inter-temporal general equilibrium (AGE) model is used to analyze different economic instruments for pollution abatement.

The major contributions of this thesis include development of I-O coefficients for energy and emission impacts, mapping the flow of resources (energy and emissions) from source to destination, characterization of consumption patterns of households in different categories, quantification of the direct and indirect energy and carbon dioxide emission impacts of household consumption patterns, and projection of energy consumption and carbon dioxide emissions for the medium term future, all using I-O models. Contributions making use of the activity analysis-based optimization model include estimation of economy wide costs of carbon dioxide emissions abatement, simulation of Indian economy with globally tradable carbon dioxide emission quotas, and analysis of the nexus between poverty and deforestation. Contributions with the AGE model include adaptation of World Bank and US EPA pollution databases for the Indian economy, and a comparative analysis of market-based instruments for pollution control such as marketable pollution permits (or equivalently pollution taxes) with a command and control type of regime.