CHAPTER 5

CLIMATE CHANGE MITIGATION

Developing countries have lower per capita income, use less energy per capita and use fuels less efficiently than industrialized countries. This less efficient use of fuels stems from both lack of state-of-the-art technology and proportionally higher use of coal, which produces more CO_2 per unit of energy used than petroleum products and natural gas. In addition, developing countries are net emitters of greenhouse gases from the burning of forests for land clearing and the burning of non-renewable biomass for cooking and other uses. The historical contribution of developing countries to global greenhouse gas concentration has been small, but commensurate with their high economic and population growth, their emissions from developing countries are expected to increase rapidly and overtake those from industrialized countries during the early decades of this century (Figure 2.9). As discussed in the earlier chapters, stabilization of greenhouse gas concentrations in the atmosphere at the 550 ppmv (parts per million volume) level will require that these countries begin to reduce their future greenhouse gas emissions by some period between 2040-2060. The exact decade when reductions will need to begin will depend on the global pathway and rate of emissions growth from now until 2100 and beyond.

The coming decades are likely to see an increase in greenhouse gas concentrations, with CO_2 levels reaching 540 to 970 ppmv by 2100 (IPCC, 2001a). Article-2 of the UNFCCC aims at stabilizing the greenhouse gas concentrations at levels that do not threaten food production and sustainable development. There is much debate, however, about the extent to which each country should take responsibility for stabilizing global climate change. In this context, as a first step, it is important to analyze the mitigation opportunities, costs and benefits, particularly in the developing countries to assist negotiators, policy makers, donor agencies, industries, farmers and so on.

5.1 THE APPROACH TO MITIGATION

Climate change mitigation analysis, which is a process of projecting future greenhouse gas emissions growth, and evaluating strategies for reducing this growth, is a valuable tool for addressing and resolving the debate between industrialized and developing countries regarding the potential available in developing countries to reduce emissions. Mitigation, a broad term, includes all activities aimed at reducing the greenhouse gas or carbon intensity of goods and services, greenhouse gas emissions and removal of CO_2 from the atmosphere, sequestering it into the biological systems. Using mitigation analysis, developing countries can discover how far and how fast they can proceed in reducing greenhouse gas emissions without jeopardizing - and indeed enhancing - their aspirations for sustainable economic development. Options for reducing greenhouse gas emissions growth, such as more efficient motors and appliances, or increased

N. H. Ravindranath et al., *Climate Change and Developing Countries*

use of wind and solar energy, are compatible with the policies and programs currently being implemented by developing countries in their pursuit of sustained economic growth. In fact, most of the countries are already pursuing options to slow the growth of greenhouse gas emissions for reasons other than the need to prevent global warming.

The sources of greenhouse gas emissions may be characterized broadly into energy and non-energy sectors. The energy sector comprises industrial end uses, transportation, domestic and commercial establishments' consumption, and energy used for agriculture, besides transformation and supply of energy. The non-energy sector includes forestry, agriculture and waste management. Most work on mitigation options to date has studied CO_2 emissions and sequestration in the energy and forestry sectors, and methane emission reduction in the agriculture sector. This chapter focuses on these issues, primarily from the point of view of developing countries, and on the technological and policy options for mitigation of climate change, followed by mitigation potential and costs.

5.1.1 Climate Change Mitigation Studies: Background

Developing country studies on climate change may be categorized into:

- *Inventory of greenhouse gas emissions,* which quantify, for a given year, the level of greenhouse gas emissions and removals of carbon from all sources and sinks in a country (see Chapter 2 for more information).
- *Mitigation studies,* which develop and evaluate strategies and activities to limit emissions and their socio-economic and environmental implications.
- *Vulnerability and Adaptation (V&A) studies*, which estimate the vulnerability to and impacts of climate change on a region or country and evaluate strategies proposed to reduce or adapt to these impacts (see Chapter 4 for more information).

Since 1989, a few major multi-country partnerships have studied opportunities for climate change mitigation in the developing world. A unique feature of most of the studies discussed in the following sections is that they were carried out by institutions within each country rather than by consultants or experts from abroad; organizations from industrialized countries provided technical assistance and training in analytical methods and tools. The results thus present perspectives of analysts from the country being analyzed. The precursors to today's mitigation studies were initiated by research groups such as the Lawrence Berkeley National Laboratory (LBNL) in the United States, which coordinated the first such effort (Sathaye, 1991). These studies focused, mainly, on the preparation of long-term energy and carbon scenarios (up to the year 2025) using a detailed end-use approach for 12 countries/groups of countries. An ambitious effort, which included the estimation of costs of mitigation options, was initiated by the UNEP's Collaborating Centre for Energy and Environment (UNEP/CCEE) at the Riso National Laboratory in Denmark (UNEP, 1994 and Sathaye and Christensen, 1994). The studies initiated under the GEF-UNDP-Asian Development Bank (ADB) project, assessed the climate mitigation opportunities, costs, benefits, barriers and policy options (ADB, 1998). A parallel research effort was coordinated by LBNL on mitigation options in the forestry sector in China and seven tropical countries, many with significant