3. Potential Impacts of Global Climate Change

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Summary. AIM/Impact model, an integrated assessment model of climate change impacts, has been developed in order to evaluate future climate change impacts and to support decision making on the global/Asia scale. AIM/Impact model consists of sub-models for evaluating impacts on major vulnerable sectors (water, agriculture, ecosystem, human health) and linkages among them. In this chapter, the general framework of AIM/Impact and examples of model outputs are introduced with a brief description of the sub-models.

3.1 Introduction

There is concern that anticipated climate change will cause significant negative damage on ecosystems and various sectors of human life. The degree of climate change and its damage depends on the pattern of future greenhouse gases (GHGs) emissions. The spatial and temporal distribution of climate change impact will be unequal, since the degree of climate change varies spatially and the adaptive capacity in relation to climate change is quite different among those affected according to their physical, economic, and social environments. The direct physical impacts of climate change on each sector may be interrelated and cause higher-order impacts. In order to evaluate alternative policies on GHGs mitigation, the consequent impacts, including higher-order effects, need to be assessed, while analysis on adaptation for the mitigation of future impacts is also important.

The AIM/Impact model, an integrated assessment model of climate change impacts, has been developed in order to evaluate future climate change impacts considering these complicated interrelationships and to support decision making on the global/Asia scale. The AIM/Impact model consists of sub-models for evaluating impacts on major vulnerable sectors (water, agriculture, ecosystem, human health) and linkages among them.

In this chapter, the general framework of AIM/Impact is presented first. Secondly, examples of model outputs are provided with a brief description of the sub-models.

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3.2 Framework of AIM/Impact Model

Figure 1 shows the linkages between the sub-models developed for the AIM/Impact study. Some sub-models have already been developed and sectoral impacts of climate change are estimated for various future climate scenarios projected using General Circulation Models (GCMs).

The FOOD sub-model consists of a productivity model for 12 crops and an agricultural trade model. The potential productivity changes caused by climate change are estimated using a 5° x 5° spatial resolution. Then, based on the estimated changes in crop productivity, the agricultural trade model calculates the allocation of the production of, and demand for, crops and other commodities that maximize social welfare.

The HEALTH sub-model examines the impact of malaria infection. It evaluates the suitability of climatic factors for the malaria mosquito to reproduce, and estimates the extent of different possible levels of malaria infection.

The VEG sub-model estimates the impact of climate change on several forest and other vegetation types. The model simulates forest collapse in regions where the rate of climate change is too high for the existing vegetation patterns to continue. The VEG sub-model also determines the value of human services provided by forests that are lost due to climate change. Work to modify the model so that it simulates dynamic changes to the vegetation is continuing.

The HYDRO sub-model uses information on climate, soil and terrain to simulate surface runoff and river discharges. The WATER sub-model estimates the future water demand at the national level and assigns that demand to each grid block, so creating a spatial distribution of water demand. Sub-models of the AIM/Emission model and of the AIM/Climate model such as the ENERGY and the CLIMATE ones are also interrelated with the sub-models of AIM/Impact in various ways. For example, the CLIMATE sub-model provides future climate scenarios for the sub-models of AIM/Impact with processing of the spatial GCM projections and observed climatology.

The sub-models that have been developed and will be developed are now related in a complex way. This complexity did not exist during the initial development stage of the project and the reasons for this are as follows:

1. It was necessary and efficient to consider long-term climate change problems simultaneously with other short-term environmental problems to develop realistic policies, especially for emissions abatement and impact adaptation. Initially, using individual sub-models with future climate scenarios was sufficient for estimating the damage caused solely by climate change in each region for each sector. However, the problems have become more complicated and recent policy requirements meant that the sub-models developed in the earlier stages had to be revised.

2. Since the initial stage, the significance of the feedback effect caused by changes in vegetation patterns and other sectors affected by climate change has been recognized. Nevertheless, due to the limited computer resources and