USING SYSTEMS ANALYSIS TO EXAMINE RELATIONSHIPS BETWEEN HUMAN DEVELOPMENT AND ENVIRONMENTAL CHANGE

Roderick Shaw
International Institute for Applied Systems Analysis (IIASA)
A-2361 Laxenburg, Austria

ABSTRACT

Conceptual models can be developed to portray the linkages between poverty, affluence and environmental change which in turn can affect human development. These conceptual models can then be "operationalized" into scientifically-based models to examine specific environment/development linkages by means of case studies. An example is given of the linkage between emissions from fossil fuel emissions in Europe and the degradation of forest resources.

1. INTRODUCTION

The United Nations Conference on Environment and Development (UNCED), to be held in Brazil in June 1992, will be a unique opportunity for collective co-operative action among nations to protect planet Earth and to enable all of its inhabitants to have a more equitable and secure future. It is obvious that there is an urgent need to reconcile several long term goals for humanity: to improve the standard of living of the 75% of the world's population living in developing countries; to prevent further environmental damage on both the global and regional scales caused by developed and developing countries; and to reverse the environmental damage that has already been caused.

It is likely that the various countries attending UNCED will come prepared to discuss very different aspects. Many developed countries are concerned about the dangers of global environmental change and will take a relatively long term perspective. On the other hand, the priority of many developing countries will understandably be on increasing the material standard of living of their populations; they will tend to take a shorter term view.

There must be a common basis of discussion during the 1992 Conference if progress is to be made. One way to accomplish this is to ensure that only the most relevant linkages between environment and development are discussed. In other words, those linkages which are most important as causes of environmental change and lack of proper development, and which would be important components of policy measures to encourage ecologically sustainable development, should be identified and emphasized.

IIASA has been asked by the World Federation of United Nations Associations to provide scientific support to the UNCED Secretariat in identifying linkages and developing the agenda. The objectives of the work, which is partially funded by the Canadian Department of External Affairs and International Trade, are to use systems analysis to:

a) examine some of the linkages between: human development; the demands and stresses development places on the environment; and the effect of stresses on and changes in the environment on future development.

b) examine ways in which environmental degradation is rooted in the structure of existing institutions, the incentives in our society, the actors involved and, conversely, how the rate and quality of human development can be limited by resource degradation and environmental change. Conceptual models for material flows, main actors and incentive structures are being formulated.

c) examine environment/development linkages in several case studies on the global, regional and sub-regional scales, using scientific models based upon the conceptual models. These case studies deal with population, energy and changes in water and food supply; energy and forest decline; industrial activity and toxification; and population, development and environment on a sub-regional scale.

d) explore the concepts of indicators of development and of environmental change, boundary conditions for sustainable development, and vulnerability, and investigate the usefulness of systems analysis for policymaking with respect to environment and development.

e) identify the scientific work needed to make promising and realistic policies implementable.

This paper will describe some of the work in connection with items c) and d) above, using the conceptual models referred to in item b), and some scientific models based upon them.

2. RELEVANT CONCEPTUAL MODELS: ELEMENTS AND LINKAGES IN THE ANALYSIS

a) General

The conceptual models that are useful to addressing the matter of environment and development are interlinked and deal with three aspects of the problem: Incentives and Constraints; Main Actors and; Physical Flows. The analysis discussed in this paper will make use mainly of the model for physical flows whose basic elements and linkages are shown in Figure 1. The population, whose numbers may or may not be changing, has a certain level of needs and desires ranging from simple survival in the short term to the accumulation of material possessions. Human society then attempts to meet these needs and desires by consuming life support materials (food and water), energy and other