SECTION 2

The Choice of First-Order Impact Models

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2.1. Introduction

The quantitative estimation of crop responses to climatic variations is a fundamental requirement for the studies reported in this volume. It is the procedure that translates a climatic perturbation (described by a climatic scenario) into a tangible first-order, biophysical effect (on crop production). Such a result can subsequently be used to evaluate further higher-order effects on agriculture and the wider economy. The quantitative tools that are used to evaluate the influence of climate on crops are termed *agroclimatic models.*

In this Section we offer an introduction to the agroclimatic models that are employed in the IIASA/UNEP case study experiments. We will focus primarily on agricultural crop models since nearly all the models described in the volume are of this type. However, much of our discussion is equally applicable to other plant models (such as the forest growth model reported in Part I, Section 5).

First, we describe briefly the complexities of the crop production systems to be modeled, showing how effectively such systems are adapted to present-day climatic variations and considering how certain components of a system might respond to changes in climate. Secondly, we look at the types of agroclimatic models that have been used to represent the crop production system. A model checklist is also introduced that summarizes features of the models used in this volume. The checklist is used, thirdly, to illustrate some advantages and limitations of using agroclimatic models for simulating the effects of present-day climatic variations. Fourthly, the additional problems (and some solutions) associated with estimating the effects of longer-term climatic change are discussed, also with reference to the checklist. Finally, to show how agroclimatic models have been used in this volume, we point to some different methods of presenting model outputs.

M. L. Parry et al. (eds.), *The Impact of Climatic Variations on Agriculture*

2.2. Climate and the Crop Production System

2.2.1. Environmental factors affecting crop growth and yield

To be able to show the effects of climatic variations on the physical processes determining crop growth, a model should respond to at least one of the variables that help to describe the climate. No matter where crop production takes place the following conditions determine the final production level: the radiative and temperature regimes and the soil water available for plant growth. There are also other environmental effects that are important for crop growth, and are themselves climate-sensitive, including the availability of plant nutrients and the interference of pests and diseases. These can be considered as indirect effects of the climate. When any of the above factors is not considered in a model, it often means that under the actual local physical environment that particular variable

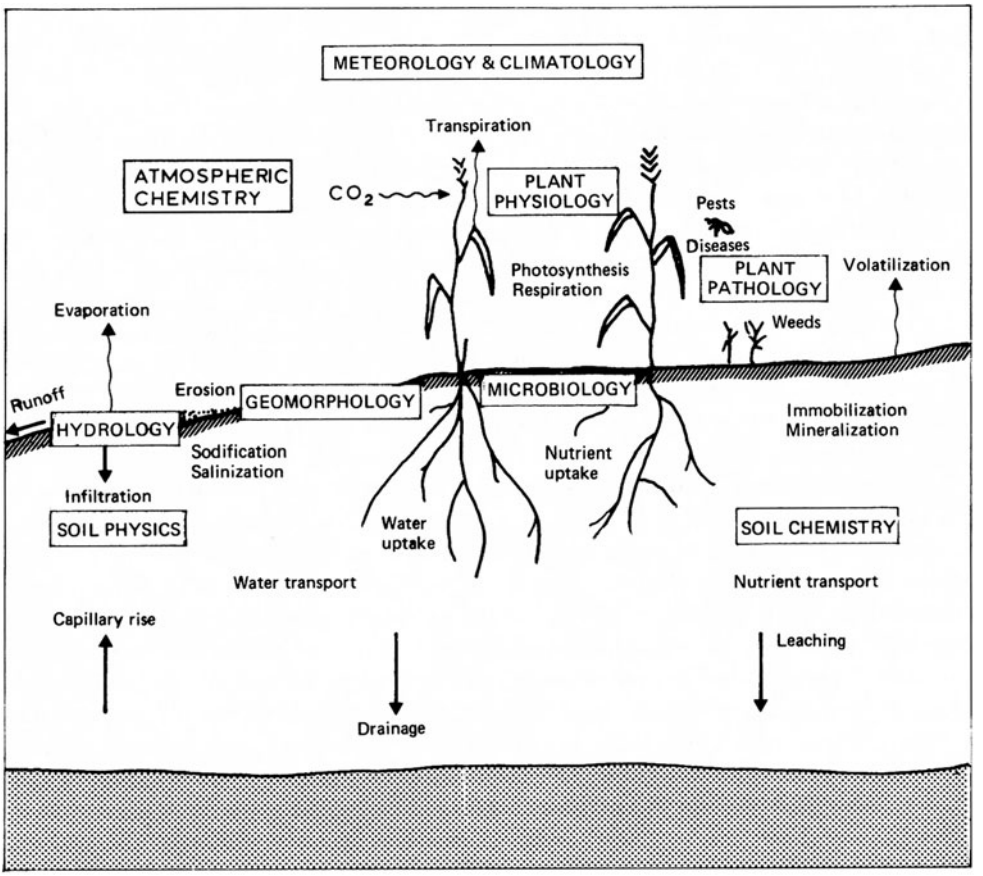

Figure 2.1. Physical processes in plant production and some research disciplines that study them.