model that is too complex cannot be easily communicated, criticized, or improved. We were looking for just those basic elements that are both necessary and sufficient to represent the mode of approach of the human population to the environmental carrying capacity. Elaborations and alternative formulations can always be inserted into the model, tested for their effects, and finally included if their effects are indeed significant. But World3 was constructed to be as simple as possible, without omitting the information required to fulfill its purpose.

Primary Model Sectors

We began the construction of World3 by representing in separate sectors the two quantities most responsible for material growth:

1. Population—incorporating the effects of all economic and environmental factors that influence human birth and death rates and thus population size.
2. Capital—including the manufactured means of producing industrial, service, and agricultural outputs.

As population and capital grow, they stimulate the development of new technologies that permit more efficient use of the earth's resources. At the same time, the increasing numbers of people and factories require more resources for their maintenance. Therefore, the model had to include representations of these resources and the dynamic processes that increase or decrease them. We included them in three sectors representing determinants of the environmental carrying capacity:

3. Agriculture—including all land and other factors influencing the effects of capital inputs on food production.
4. Nonrenewable resources—representing the fuel and mineral inputs required to make use of the capital stock for producing goods and services.
5. Pollution—standing for the persistent materials produced by industry and agriculture that may reduce human life expectancy, agricultural productivity, or the normal ability of ecosystems to absorb harmful substances.

Figure 1-2 illustrates schematically the five model sectors and the most important interactions among them. Many other sectors could be added to make the model more complete. For example, renewable resources besides food—fresh water, forest products, and fish—could be included. Like agricultural products, these resources depend on solar radiation and are produced continuously at a rate that may be enhanced by technology and reduced by pollution or misuse. We omitted them from World3, since their dynamic similarity to food indicated that their inclusion would not produce any behavior modes not already contained within the agriculture sector. Similarly, energy could be represented as a separate sector. However, the long-term behavior of fossil energy reserves is dynamically similar to that of other nonrenewable resources, so traditional energy sources were subsumed in the World3 nonrenewable resource sector. The impact of ultimate energy sources, such as fusion and solar energy, is discussed under social feedback mechanisms in section 1.7 and in the exponential technological changes section of Chapter 7.

Another aspect of the system that could be included as a separate sector is the set

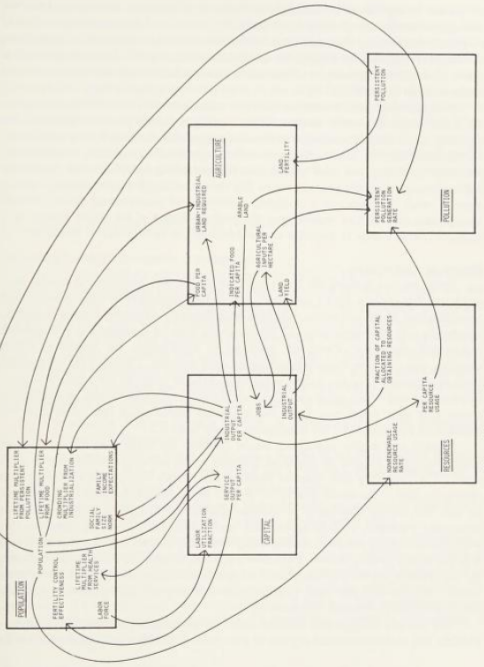

Figure 1-2 Interactions among the five basic sectors of World3