# Your ECOLOGICAL *footprint*

## The Direct and Indirect Use of Natural Resources and Emission of Wastes

Starting with Chapter 4, Your Ecological Footprint boxes will allow you to calculate your use of natural resources or environmental services or your emissions of waste. To do so, the Ecological Footprints will provide information about the amounts of natural resources, environmental services, or emission of wastes that are associated with a particular activity. These numbers are termed intensities. For example, the Ecological Footprint in Chapter 20 provides energy intensities (the amount of energy associated with a dollar's worth of various activities), whereas Chapter 13 provides carbon intensities (the amount of carbon dioxide that is emitted by a dollar's worth of various activities).

This Ecological Footprint describes the methods that are used to calculate some of these intensities. To be complete, the calculation includes both the direct and indirect uses or emissions. Direct uses or emissions often are easy to measure. For example, it is relatively easy to measure the amount of fuel you use to drive your car, heat or cool your home, and cook your food. Similarly, it is easy to measure the amount of carbon dioxide you release when you drive your car, heat or cool your home, and cook your food.

On the other hand, indirect uses are more difficult to measure because they occur elsewhere in the economy. Indirect uses or emissions often are associated with the production, transport, or disposal of a good or service. For example, how much energy was required to grow and transport the food you eat or the CD you listen to? Similarly, how much fertilizer contaminated the waterways in the process of growing your food? How much air pollution was generated by the factory that made your CD?

Although they seem small, indirect uses or emissions should not be ignored. They can be equal to or greater than direct uses or emissions. As such, intensities that include only direct uses or emissions would understate the environmental impact of your activities.

To include both the direct and indirect uses and emissions, the intensities in some of the Ecological Footprints are calculated using either life cycle analysis or input–output tables. As described in Chapter 23, life cycle analysis is used to calculate the flows of energy and materials that are associated with a specific good or service.

Input–output tables are used to track the flow of a natural resource or the emission of a waste through the entire economy. To do so, input–output tables divide purchases between intermediate and final demand sectors. Final demand sectors buy goods and services from the intermediate sector but do not resell these purchases. For example, you buy goods (such as cars and CDs) and services but do not sell them (people sell their used cars, but the value of these sales is not included in the total measure of economic activity).

Intermediate sectors buy goods and services from one another, but these purchases are designed to produce a good or service that will be resold. These purchases are termed interindustry flows. Interindustry flows of the automobile sector include the purchase of steel from the steel sector, the purchase of glass from the glass sector, and the purchase of leather from the leather sector.

The interindustry flows can be used to calculate how many cents' worth of goods and services from one sector are needed to produce a dollar's worth of output. For example, the interindustry flows associated with the automobile sector can be used to calculate how many cents' worth of rubber, glass, and leather are needed to produce a dollar's worth of car. The steel, glass, and leather sectors all purchase goods and services from other sectors; so the value of the steel purchased by the automobile sector includes all the materials purchased by the steel industry. Input–output tables trace these flows and can be used to calculate intensities that include both direct and indirect purchases.

These monetary intensities can be converted to intensities measured in physical units. Physical intensities measure the physical quantities of materials used (or emissions of wastes) that are used both directly and indirectly to produce a dollar's worth of material. For example, input–output tables can be used to calculate the quantity of energy that is used to produce a dollar's worth of automobiles, the kilograms of water that are used to produce a dollar's worth of steel, or the kilograms of carbon dioxide that are emitted to produce a dollar's worth of paper. These physical intensities are consistent with the second law of thermodynamics: All of the material that goes into the economy is contained (embodied) in the goods and services produced by the economy and its emission of wastes. No material is created or destroyed. As such, intensities measured in physical units allow you to calculate all the natural resources, environmental services, or wastes that are associated with the goods and services you purchase.

### ADDITIONAL READING

Miller, R.E., and P.D. Blair. Input–Output Analysis: Foundations and Extensions. Englewood Cliffs, NJ: Prentice Hall, 1985.

### STUDENT LEARNING OUTCOME

- Students will be able to explain why looking at only their direct purchases of energy and materials will underestimate the true size of their environmental footprint.

nect cause and effect. The Easter Islanders probably did not make the connection between the size of the rat population and the rate at which their forests were disappearing. This hid one part of a potential solution to their problem.

Equally frustrating, long lags diminish the effectiveness of environmental policy because the problem may continue long after the cause has been removed or reduced. As described in Chapter 14, several international treaties have stopped the production and trade of chlorofluorocarbons (CFCs), the chemicals that deplete ozone in the upper layers of the atmosphere. But the concentration of ozone will continue to decline because global warming in the lower layers