

### Box 4.3 The Need for Integrated Ecosystem Assessments

How can we judge whether an ecosystem is in good condition? Scientists have taken several approaches:

- *Measuring against natural systems.* Some scientists have suggested that the condition of an ecosystem could be measured by comparing one or more of an ecosystem's properties (such as biomass, number of species, or the flow of nutrients through the ecosystem) to those of a "natural" or "undisturbed" ecosystem. This would effectively define the condition of an ecosystem to be its degree of "non-naturalness." But the shortcomings of this approach for policy and management decisions are clear. Judging condition with such an indicator of "naturalness" would mean, for example, that all agroecosystems or forest plantations would be defined as being in poor condition since they are quite different from the natural ecosystems that they replaced. Moreover, given the pervasive influence of human action on the global environment, it is increasingly difficult to define what a "natural" or "undisturbed" ecosystem would be like.
- *Measuring sectoral conditions.* Many reports have been written about the state of agriculture in various countries focusing only on food production, without considering the potential negative effects of that food production on biodiversity, water quality, or carbon sequestration. Or forest assessments have examined only timber production, without evaluating the potential impact of timber harvest on regional rainfall, energy production from downstream hydro-facilities, or biodiversity loss. This strictly sectoral approach made sense when trade-offs among goods and services were modest or unimportant. But it is insufficient today, when ecosystem management must meet conflicting goals and take into account the linkages among environmental problems. A nation can increase food supply by converting a forest to agriculture, but in so doing decreases the supply of goods that may be of equal or greater importance such as clean water, timber, biodiversity, or flood control. Both local resource managers and national policy makers need some means of weighing these trade-offs, which requires a more integrated view of just what those trade-offs might entail.

- *Measuring for optimization.* An integrated assessment determines the condition of an ecosystem by assessing separately the capacity of the system to provide each of the various goods and services and then evaluating the trade-offs among those goods and services. Even if the trade-offs are conscious choices, an integrated assessment will show whether the capacity of the system to provide a *combination* of the services is optimized. For example, in an acceptably productive agroecosystem that relies on chemical inputs, separate assessments could show whether the addition of a rotation of a green manure crop could greatly reduce nutrient inputs, dramatically increase water quality, or affect agricultural yield. Thus, it could be determined whether the ecosystem was being managed to optimize the provision of a combination of food and clean water or whether these goods might have been achieved through an alternative management approach.

This approach to ecosystem assessments is called an "integrated assessment" because it examines not just a single ecosystem product, such as crop production, but an entire array of products that the ecosystem might provide. The principal benefit of an integrated ecosystem assessment is that it provides a framework for examining the linkages and trade-offs among various goods and services. The opportunity to increase the aggregate benefits from the bundle of goods and services produced by an ecosystem would be hidden in an assessment of each sector in isolation. The goal of management of the ecosystem may well be to favor one service, say, food production, over the others, but by looking at the production and condition of the entire array of services, trade-offs among various services become apparent.