Box 1.3 Water Filtration and Purification

At every stage of its journey between earth and sky, water can pick up pollutants and wastes—as it flows from a spring into streams, rivers, and the sea; as it pools into ponds and lakes; when it returns from the atmosphere as rain; when it soaks back into the soil after use on croplands or as effluent from sewage systems.

Fortunately, ecosystems can cleanse the water for us.

- Soils are inhabited by microorganisms that consume and recycle organic material, human and animal feces, and other potential toxins and pathogens. Deeper rocky layers of an aquifer may continue the cleansing process as water seeps through.
- Plants and trees hold soil in place as the water filters through. The vegetation interacts with fungi and soil microorganisms to generate many of soil's filtering capabilities.
- Freshwater bodies dilute pollutants where large quantities of municipal, agricultural, and industrial waters are drained or released.
- Wetlands intercept surface runoff, trap sediments from floodwaters, sequester metals, and excel at removing nitrogen and minerals from the water. A hectare of cattail marsh can consume three times as many nutrients as a hectare of grassland or forest (Trust for Public Land 1997:16).

In many places, however, we are straining nature's ability to filter and purify water. Where land is stripped of vegetation or overcultivated, rainwater flows downstream—unfiltered—over compacted and crusted soils. We have drained and converted half of all wetlands worldwide (Revenga et al. [PAGE] 2000), and we add levels of pollutants to watersheds that overwhelm their natural purification and dilution capacities.

To an extent, we can replace ecosystems' natural cleaning service with wastewater treatment plants, chlorination and other disinfectant processes, and artificial wetlands. But these options typically are expensive and do not provide the many other benefits supplied by forests and natural wetlands, such as wildlife habitat, open space, and flood protection.

The Costs of Clean Water

Here are some global and local indicators of our dependence on the water filtration and purification services that ecosystems provide. The human and economic costs of trying to replace them can be high.

- **Percentage of the world's population that lacks access to clean drinking water:**
  28 percent, or as many as 1.7 billion people (UNICEF 2000)
- **Number of people who die each year because of polluted drinking water, poor sanitation, and domestic hygiene:**
  5 million. Additionally, waterborne diseases such as diarrhea, ascariasis, dracunculiasis, hookworm, schistosomiasis, and trachoma cause illness in perhaps half the population of the developing world each year (WHO 1996).
- **Percentage of urban sewage in the developing world that is discharged into rivers, lakes, and coastal waters without any treatment:**
  90 percent (WRI et al. 1996:21)
- **Amount spent on bottled water worldwide in 1997:**
  $42 billion (Beverage Industry 1999)
- **Amount U.S. consumers spent on home water filtration systems in 1996:**
  $1.4 billion (Trust for Public Land 1997:24)
- **Cost incurred by households in Jakarta that must buy kerosene to boil the city's public water before use:**
  Rp 96 billion or US$52 million a year (1987 prices) (Bhatia and Falkenmark 1993:9)
- **Replacement cost of the water that would be lost if thirteen of Venezuela's National Parks that provide critical protection for urban water supplies were deforested:**
  $103 million to $206 million (net present value) (Reid forthcoming:6)
- **Typical cost to desalinize seawater:**
  $1.00–$1.50 per cubic meter (UNEP 1999:166)
- **Amount of open space and critical recharge area paved over every day in the United States:**
  11.7 km^2 (TPL 1997:3)
- **Estimated annual value of water quality improvement provided by wetlands along a 5.5-km stretch of the Alchovy River in Georgia, USA**
  $3 million (Lerner and Poole 1999:41)
- **Cost to construct wetlands to help process and recycle sewage produced by the 15,000 residents of Arcata, California:**
  $514,600 for a 40-ha system (Marinelli 1990). The city's alternative was to build a larger wastewater treatment plant at a cost of $25 million (Neander n.d.).