Focus Study 9.2 Sustainable Resources

High Plains Aquifer Overdraft

North America's largest known aquifer system is the High Plains Aquifer, which underlies a 450,600-km^2 (174,000-mi^2) area shared by eight states and extending from southern South Dakota to Texas. Also known as the Ogallala Aquifer, for the principle geologic unit forming the aquifer system, it is composed mainly of sand and gravel, with some silt and clay deposits. The average thickness of the saturated parts of the aquifer is highest in Nebraska, southwestern Kansas, and the Oklahoma Panhandle (Figure 9.2.1). Throughout the region, groundwater flows generally from east to west, discharging at the surface into streams and springs. Precipitation, which varies widely over the region, is the main source of recharge; annual average precipitation ranges from about 30 cm in the southwest to 60 cm in the northeast (12 to 24 in.). Drought conditions have prevailed throughout this region since 2000.

Heavy mining of High Plains groundwater for irrigation began about 70 years ago, intensifying after World War II with the introduction of center-pivot irrigation, in which large, circular devices provide water for wheat, sorghums, cotton, corn, and about 40% of the grain fed to cattle in the United States (Figure 9.2.2). The U.S. Geological Survey (USGS) began monitoring this groundwater mining from a sample of more than 7000 wells in 1988.

The High Plains Aquifer now irrigates about one-fifth of all U.S. cropland, with more than 160,000 wells providing water for 5.7 million hectares (14 million acres). The aquifer also supplies drinking water for nearly 2 million people. In 1980, water was pumped from the aquifer at the rate of 26 billion cubic meters (21 million acre-feet) a year, an increase of more than 300% since 1950. By 2000, withdrawals had decreased slightly due to declining well yields and increasing pumping costs, which led to the abandonment of thousands of wells.

The overall effect of groundwater withdrawals has been a drop in the water table of more than 30 m (100 ft) in most of the region. Throughout the 1980s, the water table declined an average of 2 m (6 ft) each year. During the period from predevelopment (about 1950) to 2011, the level of the water table declined more than 45 m (150 ft) in parts of northern Texas, where the saturated thickness of the aquifer is least, and in western Kansas (Figure 9.2.3). Rising water levels are noted in small areas of Nebraska and Texas due to recharge from surface irrigation, a short period of above-normal-precipitation years, and downward percolation from canals and reservoirs. (See http://ne.water.usgs.gov/ogw/hpwlms/.)

The USGS estimates that recovery of the High Plains Aquifer (those portions that have not collapsed) would take at least 1000 years if groundwater mining stopped today. Obviously, billions of dollars of agricultural activity cannot be abruptly halted, but neither can profligate water mining continue. This issue raises tough questions: How do we best manage cropland? Can extensive irrigation continue? Can the region continue to meet the demand to produce commodities for export? Should we continue high-volume farming of certain crops that are in chronic oversupply?

Scientists now suggest that irrigated agriculture is unsustainable on

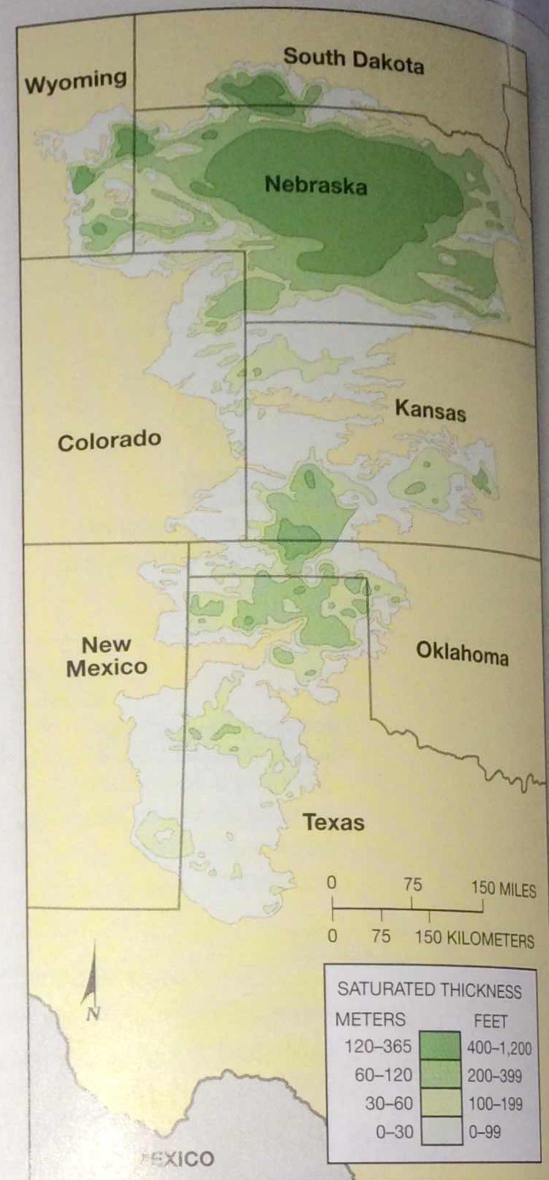

Figure 9.2.1 Average saturated thickness of the High Plains Aquifer. [After D. E. Kromm and S. E. White, "Interstate groundwater management preference differences: The High Plains region," *Journal of Geography* 86, no. 1 (January–February 1987): 5.]