

Leemans, 1993). Such influences on the climatically optimal mix of crop species would disturb patterns of traditional agriculture in some regions.

18.3.3.2. *Impacts upon Food Supplies, Costs, and the Risk of Hunger*

Since climate change may threaten food security in poorer countries within the semi-arid and humid tropics (Rosenzweig *et al.*, 1993; see also Chapter 13), poorer countries, already struggling with large and growing populations and marginal climatic conditions, would be particularly vulnerable to food shortages, malnutrition, and demographic disruption. In such countries, there is minimal capacity for adaptive change (Leemans, 1992). Already in Africa, more than 100 million people are “food insecure,” many of them in the arid Sahel region. The cost of food on world markets would increase if crop production declined in the world’s mid-latitude breadbasket regions. The large minority of the world population that already suffers from malnutrition would then face an increased threat to health from agricultural failure and rising food costs. A recent analysis predicts an extra 40–300 million people at risk of hunger in the year 2060 because of the impact of climate change, on top of a predicted 640 million people at risk of hunger by that date in the absence of climate change (Rosenzweig *et al.*, 1993).

18.3.3.3. *Impacts of Climate Change on Non-Cereal Food Production*

Climate change may influence the production of noncrop food supplies, including animal productivity. For example, the U.S. Environmental Protection Agency has identified several infectious diseases—such as the horn fly in beef and dairy cattle and insect-borne anaplasmosis infection in sheep and cattle—that could increase in prevalence in response to climate changes (Rosenzweig and Daniel, 1989). An increase in temperature and temperature extremes also could affect the growth and health of farm animals (Furquay, 1989); young animals are much less tolerant of temperature variation than are adult animals (Bianca, 1976).

Changes in ocean temperatures and currents could affect the base of the marine food web and alter the distribution, migration, and productivity of fish species, a major source of protein for many human populations (Glantz, 1992). Increased soil erosion from intensified rainfall raises the turbidity of lakes and rivers, reducing photosynthesis and therefore fish nutrition. As in agriculture, climate change may contribute to the decline of some fisheries and the expansion of others (see Chapter 16).

18.3.4. *Health Impacts of Sea-Level Rise*

Each of the vast changes in sea level that have occurred during the past million years, before and after ice ages, typically took

many thousands of years. The predicted rise of around half a meter over the next century (see Chapter 7, *Changes in Sea Level*, of the IPCC Working Group I volume) would be much faster than anything experienced by human populations since settled agrarian living began. Such a rise would inundate much of the world’s lowlands, damage coastal cropland, and displace millions of persons from coastal and small island communities (see Chapter 12).

Much of coastal Bangladesh and Egypt’s heavily populated Nile Delta would be flooded. Some low-lying, small island states such as the Maldives and Vanuatu would be at risk of partial immersion, and many other low-lying coastal regions (for example, eastern England, parts of Indonesia, the Florida Everglades, parts of the northeast coast of Latin America) would be vulnerable. The displacement of inundated communities—particularly those with limited economic, technical, and social resources—would greatly increase the risks of various infectious, psychological, and other adverse health consequences.

Sea-level rise could have a number of other effects, of varying directness, upon public health. In some locations, it could disrupt stormwater drainage and sewage disposal. Poverty and the absence of social infrastructure would compound the health consequences of storm damage, disruption of sanitation, and displacement of coastal dwellers. In many places, industrial and agricultural depletion of groundwater already are causing land subsidence, thus decreasing the threshold for impact. Meanwhile, widespread damage to coral reefs is reducing their capacity to buffer shorelines. Rising seas also would cause saltwater to encroach upon freshwater supplies from estuarine and tidal areas. Some changes in the distribution of infectious disease vectors could occur (e.g., *Anopheles sundanicus*, a saltwater vector of malaria).

18.3.5. *Climate and Air Pollution: Impacts on Respiratory and Other Health Disorders*

The incidence of respiratory disorders—many of which are caused primarily by dusts, noxious gases, allergic reactions, or infections—may be modulated by climate change. Some of these modulatory effects may occur via extreme temperatures or amplification of pollutant levels. Rapid changes in air masses associated with frontal passages may alter the intensity of respiratory illnesses (Ayres, 1990). People with chronic obstructive pulmonary disease (bronchitis and emphysema) often experience exacerbation during winter.

Seasonal allergic disorders would be affected by changes in the production of pollen and other biotic allergens; plant aeroallergens are very sensitive to climate (Emberlin, 1994). Changes in pollen production would principally reflect changes in the natural and agriculturally managed distribution of many plant species—for example, birch trees, grasses, various crops (e.g., oilseed rape, sunflowers), and ragweed species. Hay fever (allergic rhinitis) increases seasonally and may reflect the impact of pollen release. The seasonal distribution and the causation/exacerbation of asthma is more complex. It peaks in the pollen