

Water Quality Degradation Effects on Freshwater Availability: *Impacts to Human Activities*

Norman E. Peters, Member IWRA, U. S. Geological Survey, Atlanta, Georgia, USA,
and Michel Meybeck, University of Pierre et Marie Curie, Paris, France

Abstract: *The quality of freshwater at any point on the landscape reflects the combined effects of many processes along water pathways. Human activities on all spatial scales affect both water quality and quantity. Alteration of the landscape and associated vegetation has not only changed the water balance, but typically has altered processes that control water quality. Effects of human activities on a small scale are relevant to an entire drainage basin. Furthermore, local, regional, and global differences in climate and water flow are considerable, causing varying effects of human activities on land and water quality and quantity, depending on location within a watershed, geology, biology, physiographic characteristics, and climate. These natural characteristics also greatly control human activities, which will, in turn, modify (or affect) the natural composition of water. One of the most important issues for effective resource management is recognition of cyclical and cascading effects of human activities on the water quality and quantity along hydrologic pathways. The degradation of water quality in one part of a watershed can have negative effects on users downstream. Everyone lives downstream of the effects of some human activity. An extremely important factor is that substances added to the atmosphere, land, and water generally have relatively long time scales for removal or clean up. The nature of the substance, including its affinity for adhering to soil and its ability to be transformed, affects the mobility and the time scale for removal of the substance. Policy alone will not solve many of the degradation issues, but a combination of policy, education, scientific knowledge, planning, and enforcement of applicable laws can provide mechanisms for slowing the rate of degradation and provide human and environmental protection. Such an integrated approach is needed to effectively manage land and water resources.*

Keywords: *Hydrologic cycle, water pollution, watersheds, residence time, hydrologic pathways, downstream.*

Introduction

The continuing increase in global population is increasing the demand on freshwater supply. One important factor affecting freshwater availability is associated with socioeconomic development, and another factor is the general lack of sanitation and waste treatment facilities in high-population areas of developing countries. A principal cause of water scarcity is water quality degradation, which can critically reduce the amount of freshwater available for potable, agricultural, and industrial use, particularly in semi-arid and arid regions. Thus, the quantity of available freshwater is closely linked to the quality of the water, which may limit its use.

The major water quality issues resulting in degradation include water-borne pathogens and noxious and toxic pollutants. Despite efforts of United Nations organizations, international banks, and some national governments over the past several decades, human health is still at substan-

tial risk due to water quality problems in many areas of the world (World Resources Institute, 1996). In 1990, 1.2 billion people, or 20 percent of the world population, did not have access to a safe supply of water, and about 50 percent of the world population had inadequate sanitation services (United Nations Commission for Sustainable Development, 1997). The continued rapid degradation of land and water resources due to water quality degradation may result in hydrocide for future populations (Lundqvist, 1998).

Hydrogeological and biophysical environments are directly affected by changes in land use and socioeconomic processes, which are largely controlled by human activities and resource management. A land management decision is a water resource decision, a fundamental concept for addressing and implementing integrated land and water resources management (Falkenmark et al., 1999). Land alteration and associated changes in vegetation have not only changed the water balance, but typically have