Chapter 2
Industrial and Agricultural Sources and Pathways of Aquatic Pollution

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ABSTRACT

This chapter provides an introduction to the topic of aquatic pollution and looks at the major sources and pathways of pollutants to the environment from agriculture and industry. The section on agricultural pollution focuses on the use of fertilizers and pesticides. Industrial pollution covers a large topic and so three groups of pollutants are examined to provide an overview of the key issues faced within this sector.

INTRODUCTION

Development, the industrialization of society and modernization of society's way of living have resulted in the introduction of a large number of man-made substances in the environment, many of which can be harmful to both human health and other species. Synthetic chemicals are in widespread use throughout all facets of life and through accident or design, during production, consumption or disposal often end up in waterways causing pollution of water bodies. Their presence has the potential to pollute drinking water sources, contaminate food supplies such as fish, and degrade environmental quality causing potential harm to the wellbeing of humans, plants and animals. Pollution can also damage livelihoods dependent on the aquatic environment, for example fishing if stocks are contaminated or depleted as a result, and tourism if natural habitats are destroyed or if swimming waters are no longer safe.

Pollution is the addition of contaminants to a system. In terms of water, this can mean the addition of organic or inorganic substances, pathogens, large particles and floating matter, or the addition of water at a different temperature to the receiving body (thermal pollution). Water bodies across the Globe are impacted by pollution and there are very few pristine environments left.

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There are a number of different types of pollution and these are defined below. These definitions will be used throughout the rest of the chapter.

1. **Organic pollution:** The category of organic pollution is complex and includes a number of different parameters. Broadly speaking, organic pollution is the release of compounds which contain carbon, hydrogen and sometimes other elements. Natural organic compounds often breakdown readily in the environment due to a combination of processes including bacterial action. This action uses oxygen in the water and can result in oxygen depletion if the system is overloaded with organic matter. Synthetic organic compounds may be less readily degradable and can cause significant environmental issues through persistency and bio-accumulation. Persistent Organic Pollutants (POPs) are recognized under the Stockholm Convention and include polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and tributyltin (TBT). They survive in the environment for a long time, travel great distances, bioaccumulate and biomagnify, and in many cases are toxic to both wildlife and humans. POPS have been detected in polar bears in the arctic, in human breast milk and in blood samples. Organic pollutants include pesticides, detergents, solvents and many forms of industrial waste. They arise from the discharge of sewage, surface water runoff, aerial deposition, agricultural activities and industrial discharges.
2. **Inorganic pollution:** Inorganic pollutants include nutrients, sediments, heavy metals, acidity and industrial waste. The simple definition is that it is a pollutant that is not carbon based. Sources include sewage, agricultural runoff and industrial discharges.
3. **Pathogens:** Pathogens are disease causing micro-organisms such as bacteria and viruses. Their presence in water bodies can arise due to the discharge of raw sewage, for example from latrines, poorly managed septic tanks or inadequate treatment at wastewater treatment works. Storm events can also cause the release of sewage into water bodies, for example where a combined sewer system is used and it is overwhelmed with storm water and releases untreated sewage via a combined sewer overflow into the water body. Agricultural land can also release pathogens into water bodies, through run off from slurry heaps or land where livestock is intensively reared.
4. **Floating matter:** This is simply large matter which finds its way to a water body via run-off, drains, sewers and littering. It is a category that includes plastic bottles, tree debris and refuse.
5. **Thermal pollution:** Thermal pollution is where the ambient temperature of the receiving water changes due to a release. Coolant water from power plants or manufacturers can cause thermal pollution if it is not cooled before release. Impacts in the receiving water include a reduction in oxygen concentration which in turn impacts upon the ecosystem composition.

Although environmental pollution has been a problem associated with human activity over the centuries, after World War II, the type of pollution involved changed significantly, with numerous examples of catastrophic proportions. Synthetic materials such as plastics, PCBs, and pesticides like DDT associated with significant improvements to the quality of people's lives, ended up causing concern due to the way they were often produced, used, applied or disposed in many cases before there was enough evidence to show how these can be done safely. These materials have been shown not only to be toxic, but to also accumulate in the environment; they are not biodegradable, with the potential of causing human health problems such as cancers, physical birth defects, and mental disorders following exposure.

The specific objectives of this chapter include: 1. Introduction of background information on the history, impacts and sources of aquatic pollution; 2. Exploration of focused information on specific