

Chapter 1

Key Themes in Environmental Science

Case Study: Shrimp, Mangroves, and Pickup Trucks

This case study highlights the plight of a small farmer in Thailand in the shrimp farming business. He makes his living by carving out small ponds among the mangrove forests, destroying a habitat valuable for its support of coastal fisheries in the process. The small farms are not managed in a sustainable manner and when the water in the pond is so polluted with waste that it is no longer productive the farmer has to move on and carve out new ponds. One half of the world's mangroves have been destroyed. This chapter discusses the connections between people and nature, emphasizes the global scope of environmental problems, the fundamental environmental problem of population growth, the importance of urban environments, and argues for solutions based on science.

1.1 MAJOR THEMES OF ENVIRONMENTAL SCIENCE

- This book approaches environmental science by addressing six interrelated themes:
 1. human population growth
 2. sustainability of the human population and nature
 3. the global perspective
 4. an urbanizing world
 5. the connections between people and nature
 6. and science and values, arguing for solutions based on science.

A Closer Look 1.1: A Little Environmental History

- Ecology probably became a household word following the publication of Carson's Silent Spring in 1960. This was a time when biomagnification of pesticides were threatening highly visible birds of prey with extinction, including our national symbol. These early days of environmentalism were tumultuous. Times and attitudes have changed.

1.2 HUMAN POPULATION GROWTH

- Population growth- Human population density is now over 6.3 billion, having more than doubled over the past 40 years. Estimates of the maximum sustainable population size range from 2.5 to 40 billion and vary in part because of differences in acceptable standards for quality

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of life. This history of human population has been one of exponential growth, punctuated by regional scale fluctuations due to famine and communicable disease (for example, A Closer

A Closer Look 1.2: The Black Death

• Epidemics of bubonic plague spread throughout Europe in the 14th century. The disease is bacterial and is spread by fleas that live on rodents. The disease is known to have occurred in Rome in the 7th century and is thought to have originated in India. The consequences were devastating. Whole towns were abandoned. The human population actually declined significantly. There likely have been other major epidemics in the past, and others to come. Recently there was a flu pandemic in 1918-1919 that originated in Spain and that killed between 30 and 40 million people worldwide. As of 2001 mortality from AIDS is estimated to have been 20 million.

Look 1.2). Science has done much to reduce both, and to increase the speed of population growth, particularly by reducing infant mortality. However, the human population cannot grow indefinitely in violation of fundamental laws of physics and nature.

• African Famines – In the mid 1970s following drought in the Sahel region, 0.5 million Africans starved to death and millions more were permanently affected by malnutrition. This region and nations in southern Africa have been similarly affected since then by periodic drought. There appears to be a positive feedback between population, deforestation, drought and desertification. Deforestation causes the erosion by wind of silt and clay, leaving the heavier sand particles and reducing the capacity of the soil to hold water leading to desertification.

We face a dilemma. Science provides the means to increase agricultural production, survival, and population growth. Yet the conservation of our natural resources that are required to sustain the human population requires that its growth be must be controlled.

1.3 SUSTAINABILITY AND CARRY CAPACITY

• Sustainable population size is a key theme. A sustainable human population can only be reached when the resources that support the population are used in a sustained way. Sustainability has several meanings. Sustainability in the context of a resource refers to a rate of harvest or consumption that does not exceed the capacity of the resource to regenerate or to be recycled. In the context of ecosystems, sustainability is the use of an ecosystem's resources in a way that maintains essential ecosystem functions and properties (e.g. productivity, biodiversity). Sustainable development is used in an economic context to refer to economic development that can be maintained for an indefinite time without depleting the resources that support it. Sustainable growth is an oxymoron.

• Carrying capacity is a related concept. It is the maximum population size that can persist indefinitely without depleting the resources that support it. Note that maximum carrying capacity may not be a desirable objective for the human population, because quality of life may

be compromised. We must ask, what is the human carrying capacity of the Earth? How will this be achieved, by choice or by famine, war and disease?

- Achieving a sustainable global economy requires that we:
 1. Develop an effective population control strategy
 2. Restructure energy resources (an economy based on fossil fuel is not sustainable)
 3. Develop an economic plan and tax structure that will promote 1 & 2.
 4. Implement appropriate social, legal, political and educational changes

1.4 A GLOBAL PERSPECTIVE

- Human population size has now reached a scale where the environmental impacts are global in scale and will require multilateral solutions. Examples include changes in the chemistry of earth's atmosphere. The build up of CO₂ in the atmosphere is a global problem that crosses all international boundaries. The earth's circulatory system, its atmosphere and hydrosphere, are vulnerable. This Gaia hypothesis, developed by James Lovelock and Lynn Margulis, addresses the feedback mechanisms that operate on a global scale to maintain the earth in a dynamic equilibrium that favors the continuity of life (not necessarily human life). This is discussed in more detail in Chapter 3.

1.5 AN URBAN WORLD

- Driven by technology and economics, the human population is rapidly urbanizing (see the night lights in Fig. 1.7). This presents unique environmental challenges, but also opportunities to solve environmental problems. About 75% of the population in developed nations live in urban areas; this drops to 40% in developing nations. By 2015 the world will have about 36 megacities, 23 of them in Asia, each with populations exceeding 8 million people and by 2025 2/3 of the population will live in cities. The scientist James Lovelock, one of the creators of the Gaia hypothesis, has said that in order to survive and to preserve our biological life support system, humans should live in domed cities, isolated from nature.

A Closer Look 1.3: Carrying Capacity of the Chinook Salmon

- A common approach to determining the sustainable harvest of a resource is to examine the historical records to see if the annual harvest has remained constant. See Fig. 1.6.

1.6 PEOPLE AND NATURE

- Two paths lie before us. One in which we view nature as something that humans can control and another in which we see humans and nature as inseparable, and where the interactions are reciprocal.

1.7 SCIENCE AND VALUES

- Solutions to our environmental problems require knowledge of natural science. Basically, how does nature work? We must know enough to find solutions and also to recognize problems as problems when they arise. Take the loss of ozone in the atmosphere for example. That was recognized by scientists as a crisis in the making, the cause was identified, and a solution was found. However, solutions must be consistent with basic human values and rights, and in a free society, and in a free society the population and its representatives should have enough knowledge to generally understand the solutions, their costs, benefits and the consequences.

Critical Thinking Issue. How can we preserve the world's coral reefs?

- About 10% have been destroyed and they are dying at an alarming rate; an additional 30% or threatened. Fishing with explosives in some parts of the world, harvest of coral for the precious stone market, introduced predators, and disease related to climate change, acidification of the ocean, and water quality are major problems. They have enormous ecological value in sustaining fisheries, aesthetic value that stimulates tourism, and they reduce the impacts of coastal storms. Their limestone skeletons are sometimes mined for construction materials. They are extremely slow growing.

How does the coral problem relate to the key themes?

What utilitarian, ecological, moral and aesthetic values do they have?

What can you do to help preserve coral reefs?

- How do we place a value on the environment? The environmental can be viewed as having aesthetic, creative, inspirational, recreational, moral, cultural, ecological and utilitarian values. Utilitarian values, like the value of timber and mineral wealth that can be extracted, are relatively easy to evaluate. Ecological values refer to the life-support functions of ecosystems, the water quality benefits that derive from ecosystems and so on. Moral values relate to the rights of all living things to exist, and cultural values are the support provided by ecosystems to unique and valuable cultures (e.g. the Cajun culture).

