

1.4: Natural Capital of the Earth

All of that very small group of humans who have been privileged to view Earth from outer space have been struck with a sense of awe at the sight. Photographs of Earth taken at altitudes high enough to capture its entirety reveal a marvelous sphere, largely blue in color, white where covered by clouds, with desert regions showing up in shades of brown and red. But Earth is far more than a beautiful globe that inspires artists and poets. In a very practical sense it is a source of the life support systems that sustain humans and all other known forms of life. Earth obviously provides the substances required for life including water, atmospheric oxygen, carbon dioxide from which billions of tons of biomass are made each year by photosynthesis, and ranging all the way down to the trace levels of micronutrients such as iodine and chromium that organisms require for their metabolic processes. But more than materials are involved. Earth provides temperature conditions conducive to life and a shield against incoming ultraviolet radiation, its potentially deadly photons absorbed by molecules in the atmosphere, their energy dissipated as heat. Earth also has a good capacity to deal with waste products that are discharged to the atmosphere, into water, or into the geosphere.

The capacity of Earth to provide materials, protection, and conditions conducive to life is known as its **natural capital**, which can be regarded as the sum of two major components: **natural resources** and **ecosystem services**. These conditions are giving rise to a new business model termed **natural capitalism**. Early hunter-gatherer and agricultural human societies made few demands upon Earth's natural capital. As the industrial revolution developed from around 1800, natural resources were abundant and production of material goods was limited largely by labor and the capacity of machines to process materials. But now population is in excess, computerized machines have an enormous capacity to process materials, and the availability of natural capital is the limiting factor in production including availability of natural resources, the vital life-support ability of ecological systems, and the capacity of the natural environment to absorb the byproducts of industrial production, most notably greenhouse gas carbon dioxide.

Rather than the adversarial relationship that has prevailed between the traditional business community and environmentalists with regard to economic development, a functioning system of natural capitalism properly values natural and environmental resources. The goal of natural capitalism is to increase well-being, productivity, wealth, and capital while reducing waste, consumption of resources, and adverse environmental effects. The traditional capitalist economic system has proven powerful in delivering consumer goods and services using the leverage of individual and corporate incentives. A functional system of natural capitalism retains these economic drivers while incorporating sustainable practices such as recycling wastes back into the raw material stream and emphasizing the provision of services rather than just material goods. In so doing a system of natural capitalism emulates nature's systems through the practice of industrial ecology, discussed in detail in Chapter 14, and the application of the principles of green chemistry (see Chapter 2).

The development of a functional system of natural capitalism requires several important changes in business practices. These include the following:

1. Implement technologies that are highly productive with greatly reduced use of nonrenewable minerals and energy.
2. Develop systems in which waste materials and energy from one sector are utilized by another sector (a functioning system of industrial ecology).
3. Change business models from those that emphasize selling goods to those that concentrate upon providing services, for example, by selling fewer automobiles and providing better mass transportation systems.
4. Reinvest in natural capital to increase production of ecosystem services. An example is the provision of constructed wetlands as part of wastewater treatment systems to provide wildlife breeding grounds along with finishing of treated wastewater effluent.

Evolution of the Utilization of Natural Capital

Figure 1.4.1 shows the burden on Earth's natural capital as a function of the progression of economic development. During pre-industrial times the capacity of humans to deplete natural capital was minimal, largely because of limitations on the rates at which energy could be used. As the industrial revolution developed and humans learned how to harness energy sources, particularly from fossil fuels, Earth's natural capital was increasingly consumed in areas such as exploitation of depleting resources and utilization of the hydrosphere, geosphere, and atmosphere for the disposal of wastes. As industrialization progressed, it became increasingly obvious that it was causing problems in areas such as air and water pollution, soil erosion exacerbated by the capabilities of fossil-fueled tillage machinery to disturb soil, and depletion of rich ore sources necessitating the mining of much larger amounts of less rich ores to obtain needed quantities of

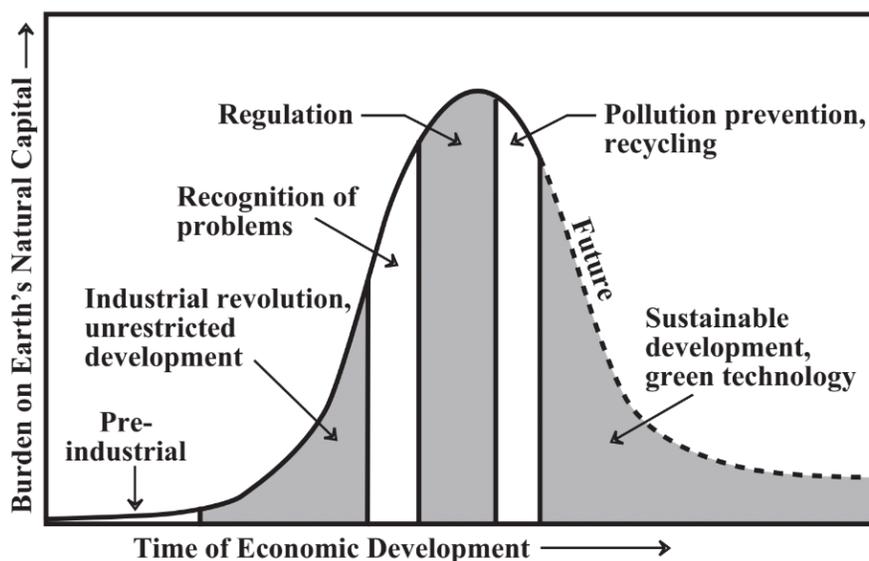


Figure 1.4.1. Stages of economic development with respect to utilization of Earth's natural capital.

metals and other geospheric resources. As a consequence, laws were passed and regulations put into place to reduce pollution and to conserve resources. Particularly after the devastating Dust Bowl years of the 1930s in which much productive topsoil was lost to wind erosion, the U.S. government initiated programs of soil conservation with incentives to preserve the essential soil resource. Efforts to reduce air and water pollution concentrated initially on the most obvious pollutants, such as particles emitted from smokestacks, followed by greater emphasis upon more insidious pollutants, such as heavy metals in water. The regulatory approach has been evolving into one that emphasizes pollution prevention, recycling, and conservation of energy and materials. A final phase is sustainable development and utilization of green technology that can support growing economic development while substantially reducing exploitation of Earth's natural capital.

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