Ecology for Designers

Okala Practitioner Chapter 16

Ecological principles

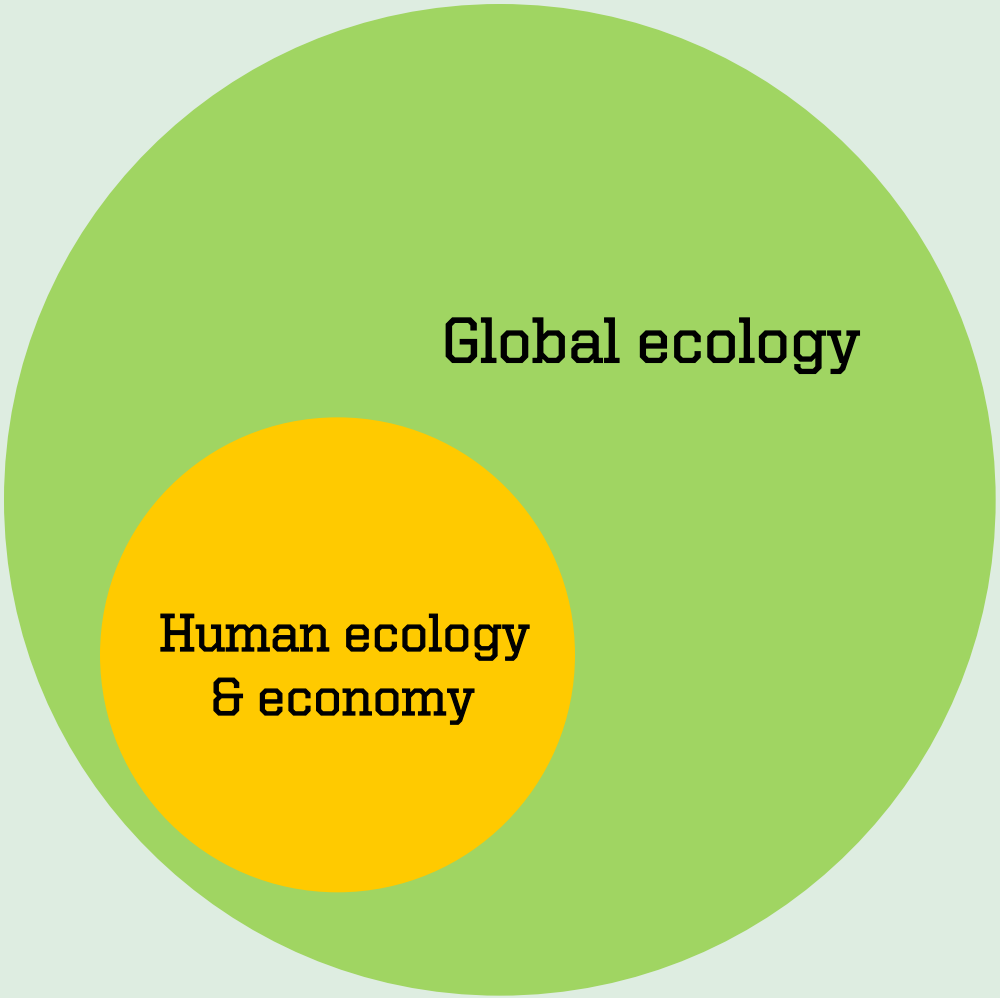
Ecology is the branch of biology that studies the relationships among organisms and their environment.

Global ecology encompasses the largest scale of ecology. It includes land, waters, atmosphere, organisms, habitats, material cycles and the relationships among these parts.

Global ecology is **finite.** Although small amounts of dust from outer space falls onto the Earth, the global ecology behaves like a closed system.

Ecological principles

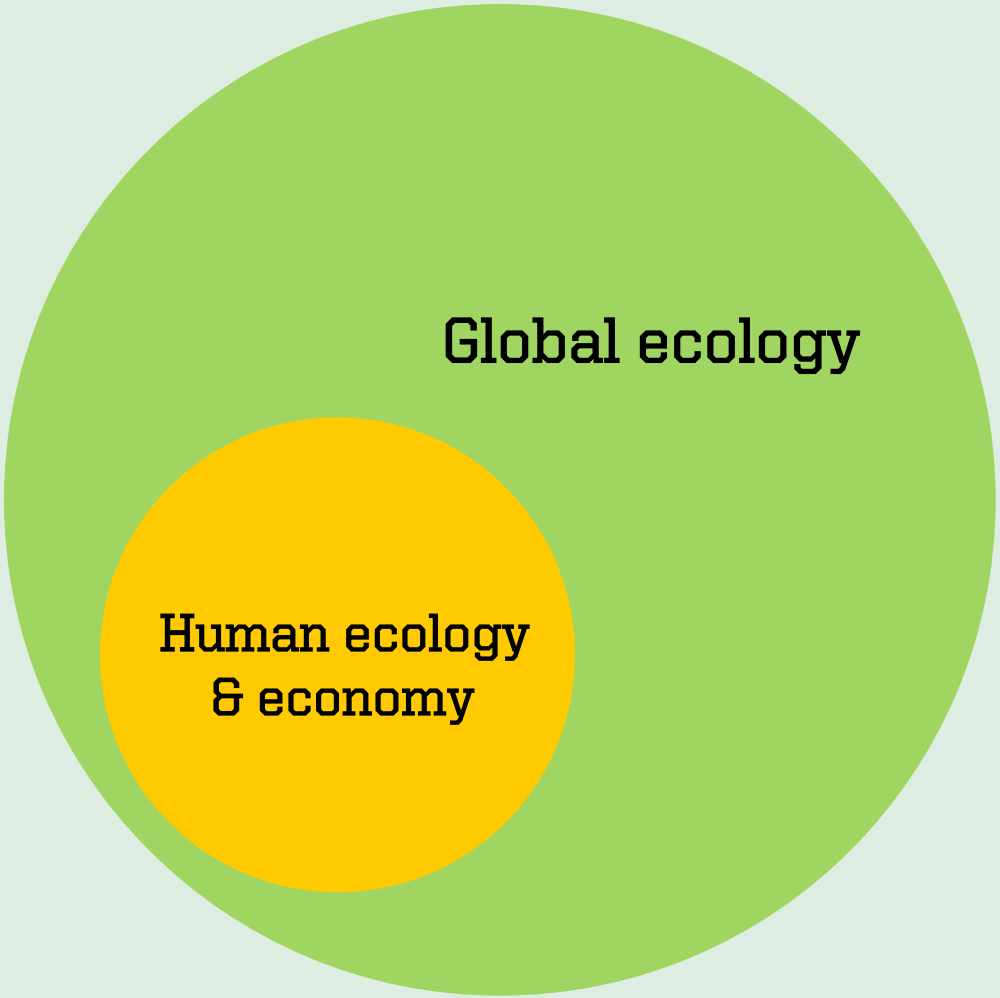
Human ecology is a subset of ecology that studies the interactions among human populations and the Earth's ecosystems.



Ecological principles

The economy is wholly dependant on the global ecology for primary services such as air, water, resources, food and waste processing.

This is the opposite of our dominate economic theory that the biosphere is a subset of the economy - an infinite source of raw materials and recipient of infinite amounts of waste.



Ecological principles

Immature ecosystems

- Immature ecosystems have a small number of competitive, quickly growing species. An example of an immature system is a forest a few years after a fire with a small diversity of quickly growing weeds and trees.

- Immature systems use most of their available energy for growth.

Ecological principles

Mature ecosystems

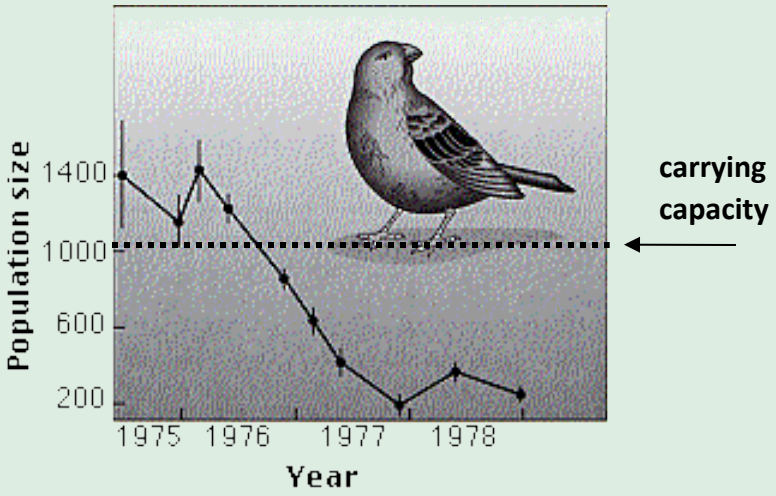
- Mature ecosystems contain a large number of species with stable populations. A mature system holds many different kinds of plants and organisms.
- Mature ecosystems use most energy to cycle materials.
- Sustainability implies that the human economy will eventually stabilize and live off of the Earth's net solar income, like a mature ecosystem.

Ecological principles

Carrying capacity

$$\text{Carrying capacity} = \text{number of species} \times \frac{\text{population}}{\text{specie}} \times \frac{(\text{waste} + \text{resource depletion})}{\text{individual}}$$

- Carrying capacity defines the number of different organisms (species) and population per organism which a habitat allows. If a population exceeds its carrying capacity, the population will be reduced by depletion of food, disease or excessive waste.
- Species overpopulation can cause a population to crash far below the carrying capacity, sometimes to the point of extinction.
- Carrying capacity is difficult for experts to fully understand, as is to be expected for such a complex concept.



This graph shows an example of a Finch species population nearing extinction.

Ecological principles

Capacity to sustain the human population

The capacity of the biosphere to sustain humans is characterized by this equation*:

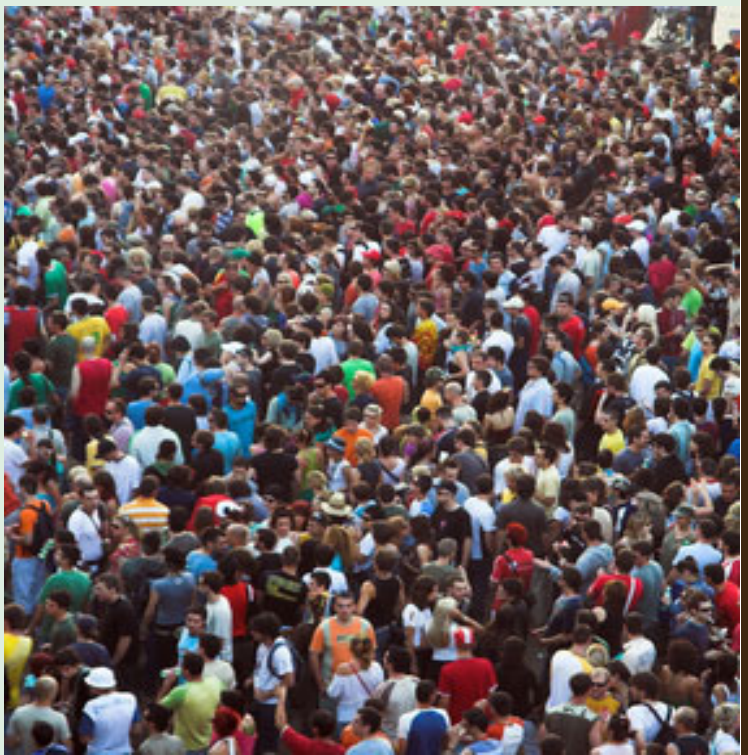
$$\text{Human ecological impacts} = \text{human population} \times \frac{\text{wealth}}{\text{person}} \times \frac{(\text{pollution} + \text{resource depletion})}{\text{unit wealth}}$$

* (IPAT equation) Ehrlich and Holdren, 1971

All factors in the equation are increasing:

- human population
- average per person wealth*
- pollution per unit wealth*

* This refers to economic wealth. It does not enter encompass the value of intellectual wealth and cultural wealth.



Ecological principles

Capacity to sustain human population

Humans now dominate the biosphere to a significant degree and are interfering with substantial portions of primary biological processes.

- Estimates indicate that humans use 8% of the primary productivity of the oceans (25% for upwelling areas and 35% for temperate continental shelf areas). We use more than half of the accessible surface fresh water.

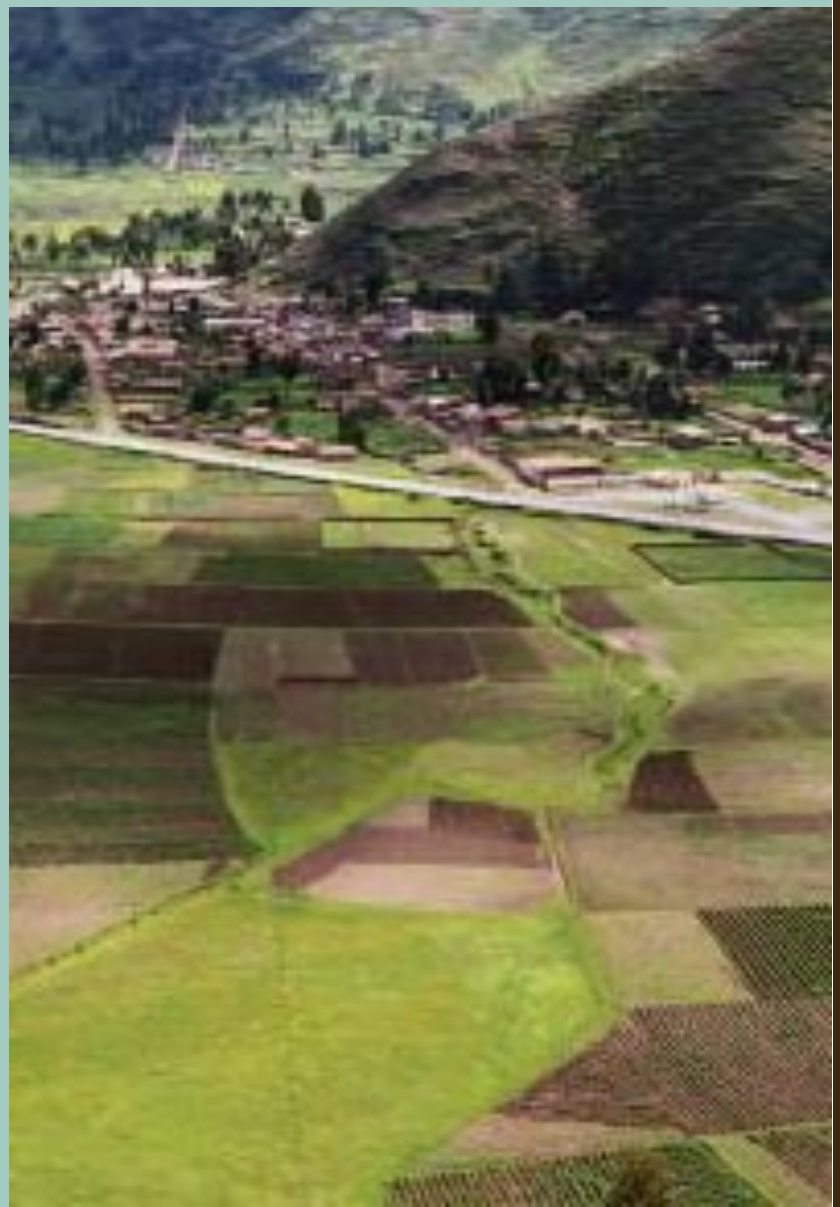
- 22% of marine fisheries are overexploited or depleted, 4% more are at the limit of exploitation.

Ecological principles

Human disruption of ecosystems

- Humans have already transformed or degraded 50% of the Earth's land surfaces by agricultural activity and urban growth.

- On many islands, more than half of plant species have been introduced by man; on continental areas the fraction is 20% or more.

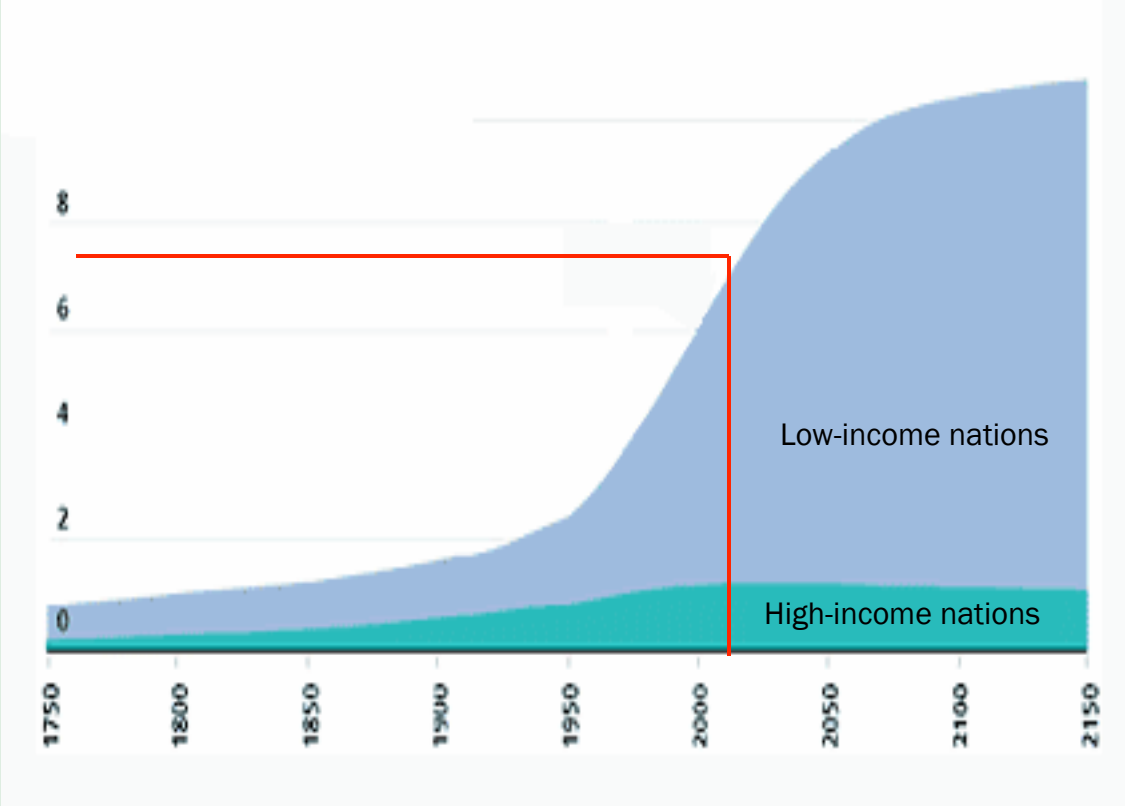


Ecological principles

High-income vs. low-income populations

Most population growth occurs in the poorer nations, as the adjacent graph illustrates.

The richer nations, however, consume far more resources and create far more environmental damage per person.



Projected human population growth, in billions: 1750 – 2150

Ecological principles

High-income vs. low-income populations

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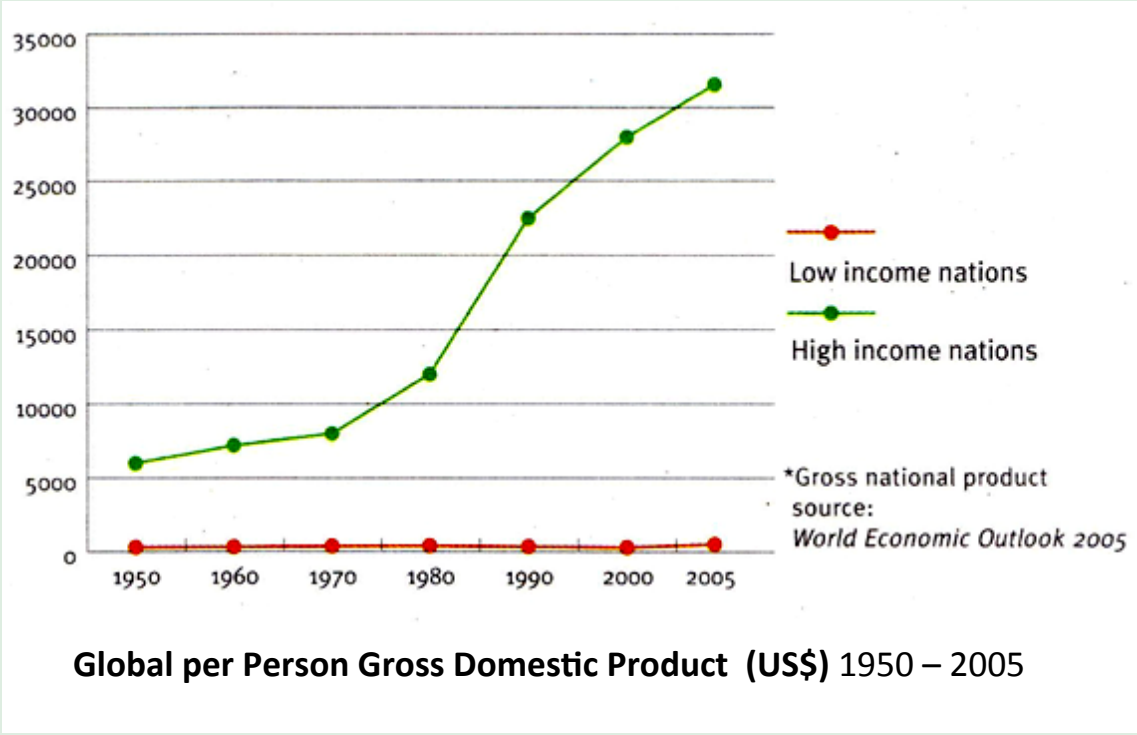


Global per Person Gross Domestic Product (US$) 1950 – 2005

Discussion:

Is reducing population growth in low-income nations a worthwhile goal?

Is reducing per capita pollution in high-income nations a worthwhile goal?

How might we best achieve these goals?

Ecological principles

Sustainable economy

A sustainable economy would use only the net available solar energy. Such a system would consume a fixed and non-growing amount of physical resources, like biological systems.

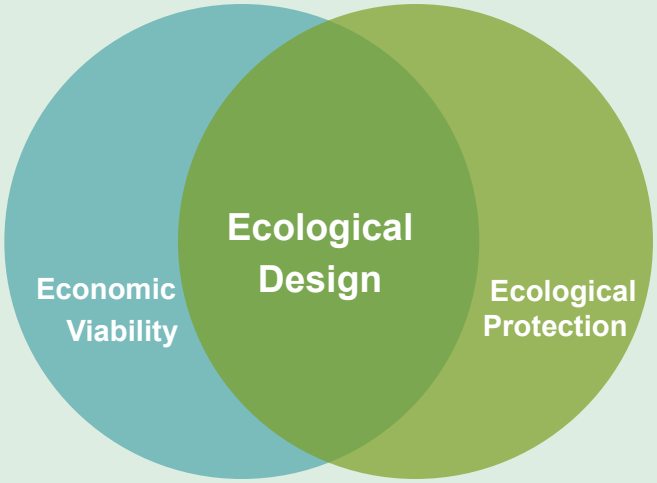
In such a steady-state system, the term “sustainable economic growth” is a contradiction.

Source: *VALUING THE EARTH*: *Economics, Ecology, Ethics,* Herman E. Daly and Kenneth N. Townsend, 1993

Ecological principles

Ecological Design is:

Environmentally benign
and Economically viable



Ecological principles

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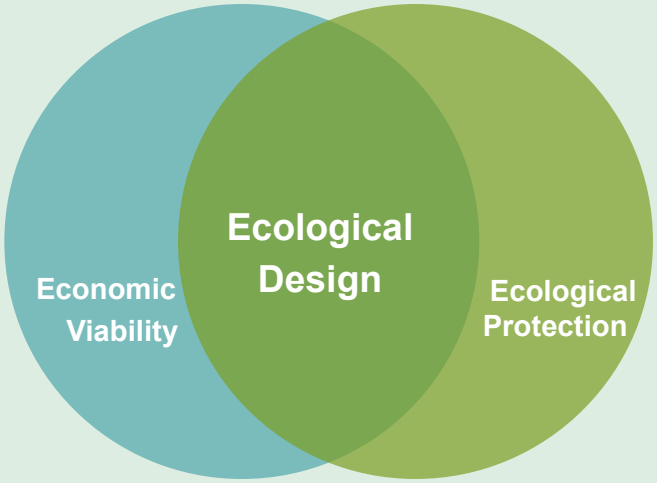
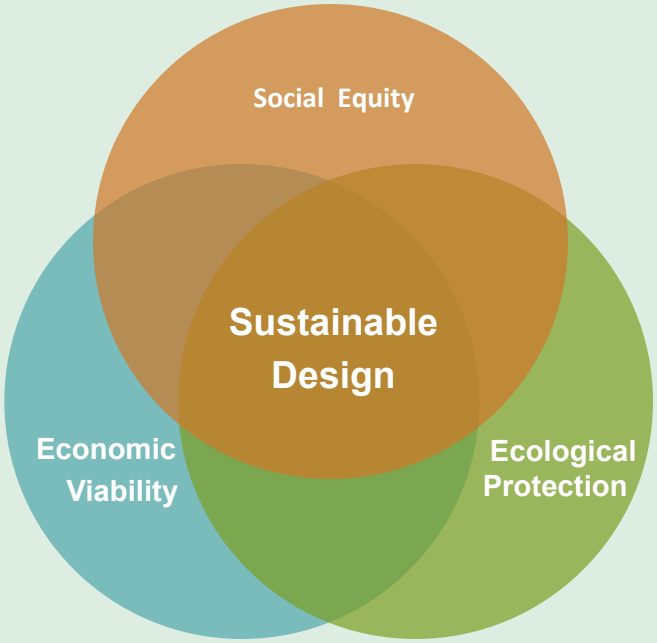


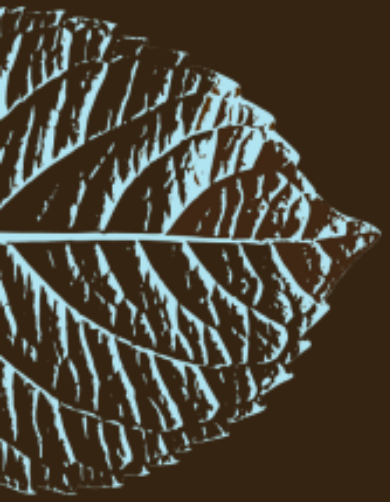
Sustainable Design is:

Environmentally benign
Economically viable
AND Socially equitable



Summary: Ecological Principles

1. Human ecology and economy are dependent on the larger global ecology for many essential services.
2. Enabling the human economy to eventually stabilize and live within the Earth's net solar income, like a mature ecosystem, is a sustainability goal.
3 The growing human population will continue to increasingly damage the biosphere, and will surpass the Earth's long-term capacity to sustain the human population, unless significant changes are made in human behaviors.
4. Ecological Design is environmentally benign and economically viable, while Sustainable Design must also be socially equitable.



Okala Practitioner

Integrating Ecological Design

This presentation is part of an educational presentation series that supports teaching from the *Okala Practitioner* guide.

Okala Practitioner and these presentations were created by the Okala Team to disseminate fact-based knowledge about ecological design to the design disciplines and business.

Unless provided in the presentations, Information sources are found in the *Okala Practitione*r guide.

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The Okala Team initiated the collaboration with the US EPA and the Industrial Designers Society of America (IDSA) in 2003. The team developed Okala Practitioner with support from Autodesk, IBM, Eastman Chemical and the IDSA Ecodesign Section.

Okala Practitioner is available through amazon.com.

More information and the free Okala Ecodesign Strategy App are found at Okala.net.