

Land, Public and Private

Chapter 10



IV. Land and Water Use (10-15%)

- A. Agriculture
- B. Forestry
- C. Rangelands
- D. Other Land Use



Module 29: Land Use Concepts and Classification

After this module you will be able to.....

- 1) Explain how human land use affects the environment
 - 2) Describe the various categories of public land used globally and in the United States
-

Human Land Use



Over time, we have altered land to meet our needs. This includes agriculture, housing, recreation, industry, mining, and waste disposal. Although these activities benefit humans, they can have negative environmental effects. Examples include mudslides and climate change from logging and deforestation, paving land reroutes water runoff, and soil degradation can occur from overuse of farmland. Three concepts that this chapter will look at pertaining to land use are **tragedy of the commons**, **externalities**, and **maximum sustainable yield**.

The Tragedy of the Commons

In certain and early societies, land was viewed as a common resource. This means anyone could use the same land for foraging, growing crops, felling trees, hunting, or even mining. This led to many problems such as overgrazing, overharvesting, and deforestation.

Ecologist Garrett Hardin coined a term for this called **tragedy of the commons**, or the tendency of a shared, limited resource to become depleted because people act from self-interest for short-term gain.



The Tragedy of the Commons

Not having any kind of regulation or agreement on land use leads to overuse very quickly. For example, imagine a communal pasture on which multiple farmers graze their sheep. It begins with no single farmer having too many sheep. Each farmer is tempted to add another sheep for self-gain. This leads to the total number of sheep exceeding the capacity of the land.

We consider this a “tragedy” because in the end, everyone suffers and there are no winners. This applies not only to agriculture, but any publicly available resources that are not regulated such as land, air, and water.

The Tragedy of the Commons

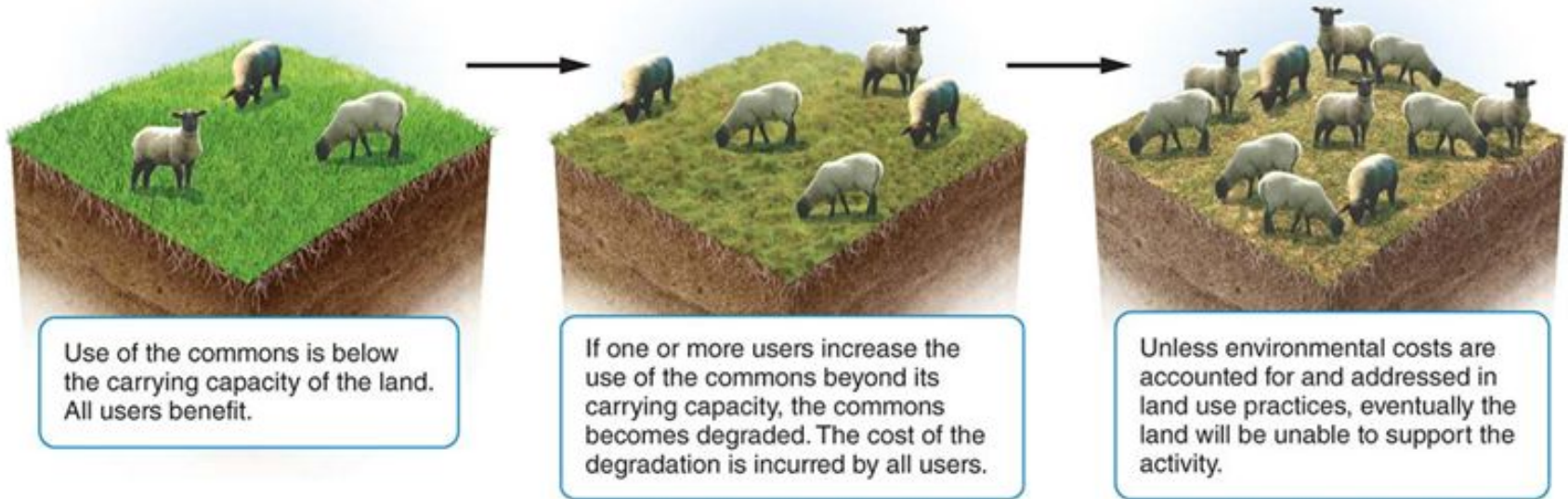


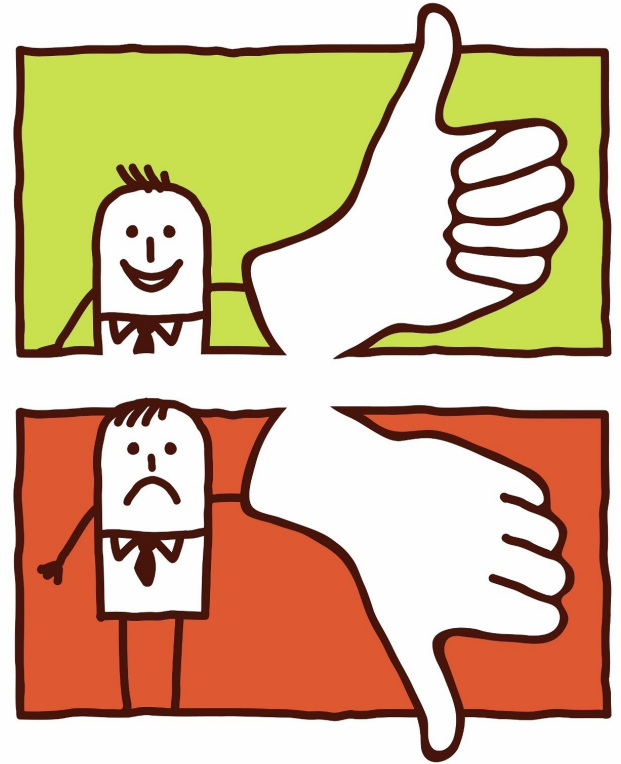
Figure 29.2
Environmental Science for AP®, Second Edition
© 2015 W.H. Freeman and Company

Externalities

An **externality** is a cost or benefit of a good or service that is not included in the purchase price.

Example: A bakery opens up next door to you. A positive externality is that you get to wake up every morning to the delicious smell of fresh baked goods. A negative externality is that they may start working at 3:00 AM and you cannot sleep due to excessive noise.

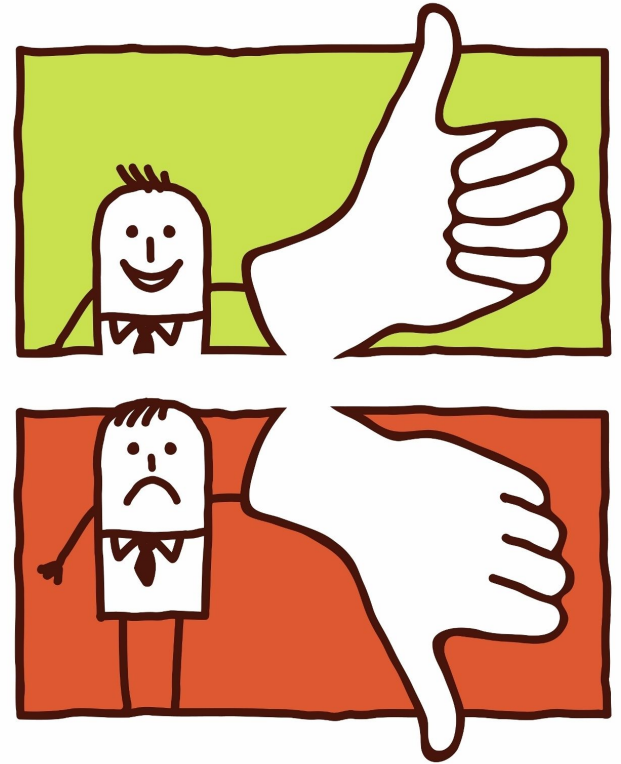
In environmental science we are concerned with negative externalities because they often lead to serious environmental damage for which no one is held legally, financially, or morally responsible.



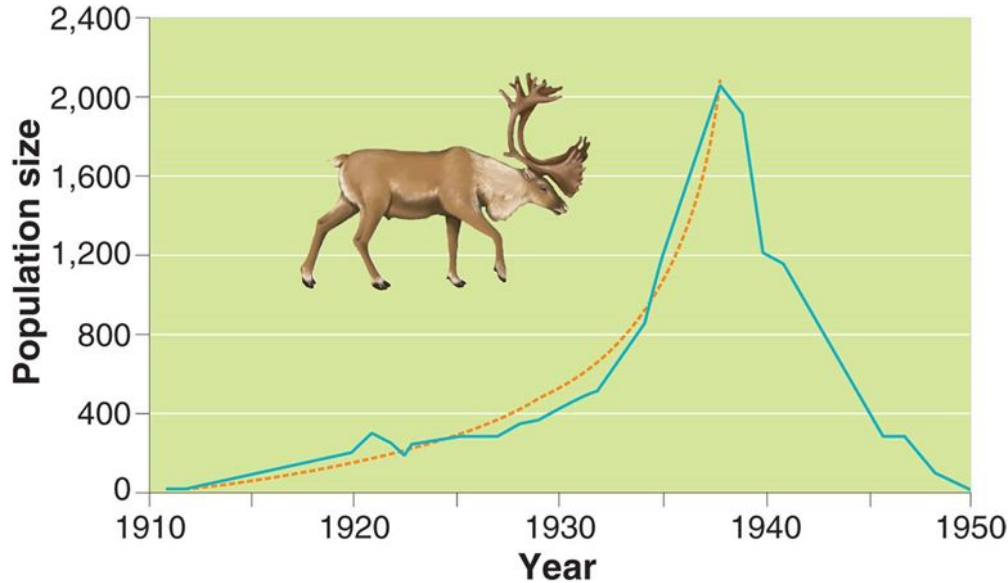
Externalities

Using the sheep example previously, a negative externality would be farmers needing to seek new land for their sheep to graze due to overuse.

Some economists maintain that private ownership can prevent tragedy of the commons since a landowner is much less likely to overgraze his own land as opposed to someone else's. The government could also pass an ordinance that permits only a certain number of sheep to graze.



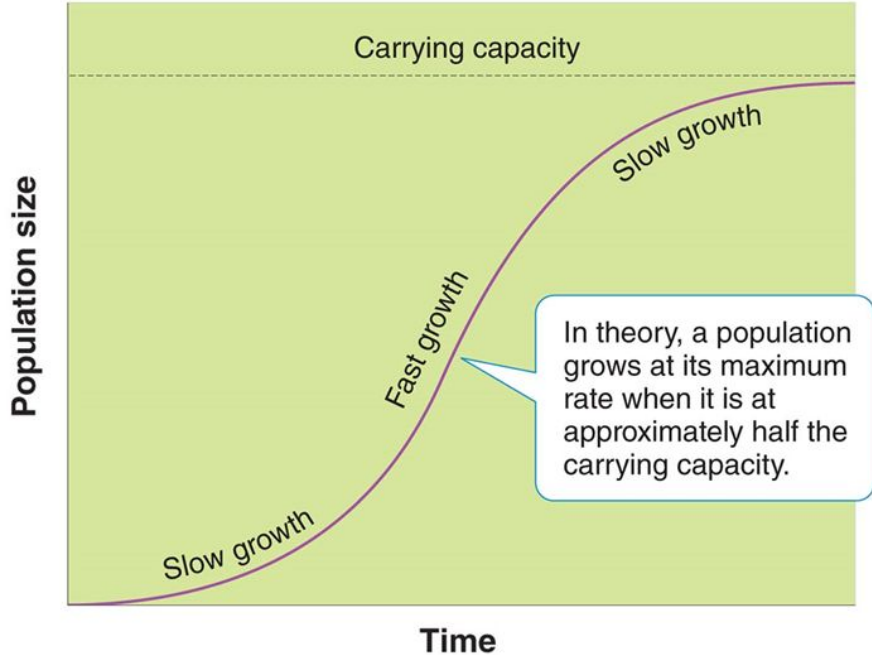
Maximum Sustainable Yield



When harvesting a biological resource we need to determine the maximum amount that can be harvested without harming the resource as a whole. St. Paul Island in Alaska is an extreme case where the population of reindeer grew so large that it crashed due to starvation.

Figure 19.3
Environmental Science for AP[®], Second Edition
Data from V. B. Scheffer, "The rise and fall of a reindeer herd," *Scientific Monthly* (1951): 356–362

Maximum Sustainable Yield



An intermediate amount of hunting allows enough adult deer to reproduce at that rate that maintains the population, but not leave so many that there is too much competition for food. This intermediate harvest is called **maximum sustainable yield (MSY)**, or the maximum amount of a renewable resource that can be harvested without compromising the future availability of that resource. Although MSY varies case by case, a reasonable starting point is to assume that population growth is the fastest at about one-half the carrying capacity of the environment.

Maximum Sustainable Yield



Note that it's very difficult to calculate MYS. This is because it's not easy to obtain necessary information such as birth rates, death rates, and the carrying capacity of a natural ecosystem.

Many scientists also believe that using MSY is not an adequate guide to use for environmental protection. They believe that unmeasured externalities and harm to the ecosystems can occur when using MSY as a harvest guideline, and that the best way to protect the environment is to harvest considerably less than the MSY.

International Categories of Public Lands

The 2014 United Nations List of Protected Areas classified protected public lands into six categories according to how they are used:

1. National parks
 2. Managed resource protected areas
 3. Habitat/species management areas
 4. Strict nature reserves and wilderness areas
 5. Protected landscapes and seascapes
 6. National monuments.
-

National Parks

Why?

Scientific, educational, and recreational use.
In most cases they are NOT used for extraction of resources such as timber or ore.

Examples

Yellowstone, Yosemite, Grand Canyon, Acadia in the U.S.
Amboseli, Serengeti, Kruger in Africa (These generally protect animal species such as elephants, rhinos, and lions)

Management

Controlled burns to removed deadwood

Managed Resource Protected Areas

Why?

Opened for sustained use of biological, mineral, and recreational resources

Examples

National forests in the United States

Management

Mining, logging, and other activities are sometimes allowed and can even be encouraged

Habitat or Species Management Areas

Why?

Maintain biological communities

Examples

Karelia (NW Russia and bordering areas of Finland) has one of the highest proportions of protected areas in Europe. 5 percent of its total area. Of this total, more than ½ consists of habitat or species management areas that are actively managed for hunting and conservation.

Management

Introduction of fire (some species, such as some pine trees, produce a type of seed that can only be released from a fire)

Strict Nature Reserves and Wilderness Areas

Why?

Protect species and ecosystems

Examples

Chang Tang Reserve in China was set aside to protect a number of species, including the declining population of wild yak

Protected Landscapes & Seascapes

Why?

Protect natural resources and species, tourism, and recreation

Examples

Orchards, villages, beaches (about 6,500 worldwide)
Batanes Protected Landscape and Seascape in the Philippines

National Monuments

Why?

Protect unique sites of special natural or cultural interest

Examples

Arc de Triomphe in Paris
Bear Ears National Monument in Utah

Management

Eviction and exclusion of indigenous human populations from the land (creating humanitarian crises)

[See Mau Forest in Rift Valley of Kenya evictions in 2009](#)

Protected Land and Marine Areas of the World

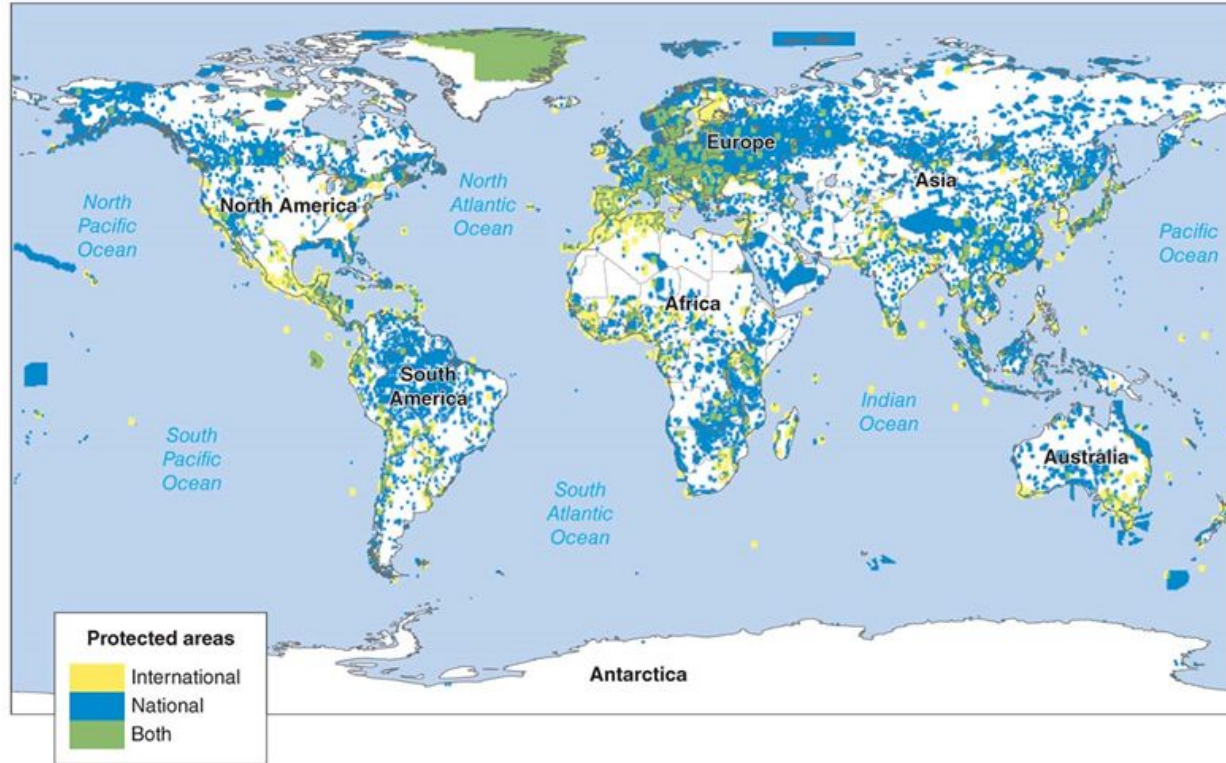


Figure 29.4
Environmental Science for AP[®], Second Edition
Data from http://protectedplanet.net/#2_43.5_-72.25_0

Public Lands in the United States

Public land in the United States may be owned by federal, state, or local governments. **Currently, 42 percent of our land is publicly held, which is a larger percentage than any other nation.** The federal government is by far the largest single landowner in the United States, owning roughly 28 percent of the country. **Like private land, grazing is the most common use of public land in the United States.**

Public Lands in the United States

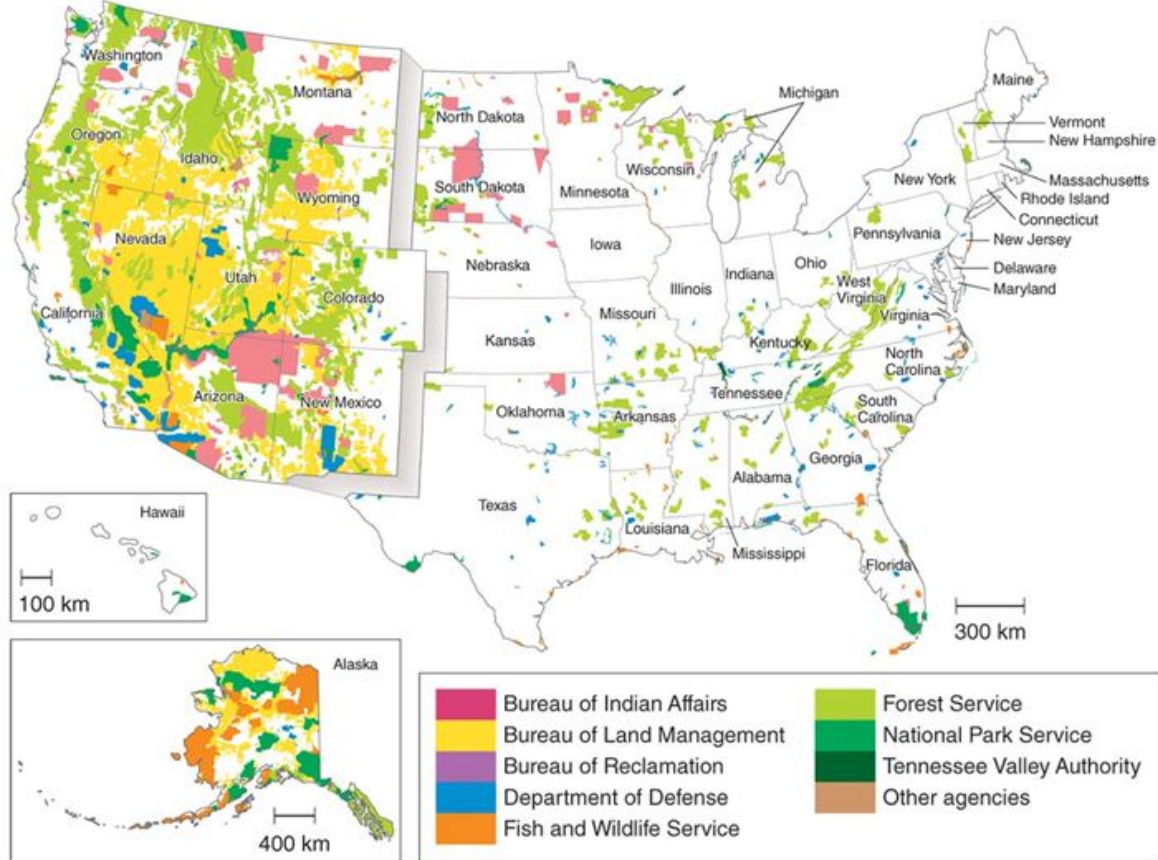


Figure 29.5
Environmental Science for AP[®], Second Edition
After <http://nationalatlas.gov>

Public Lands in the United States



Note that public lands in the United States includes rangelands, national forests, national parks, national wildlife refuges, and wilderness areas. The **resource conservation ethic** is the belief that people should maximize resources, based on the greatest good for everyone, and calls for policy makers to consider how this public land is used. This means that areas are preserved and managed for economic, scientific, recreational, and aesthetic purposes.

Public Lands in the United States

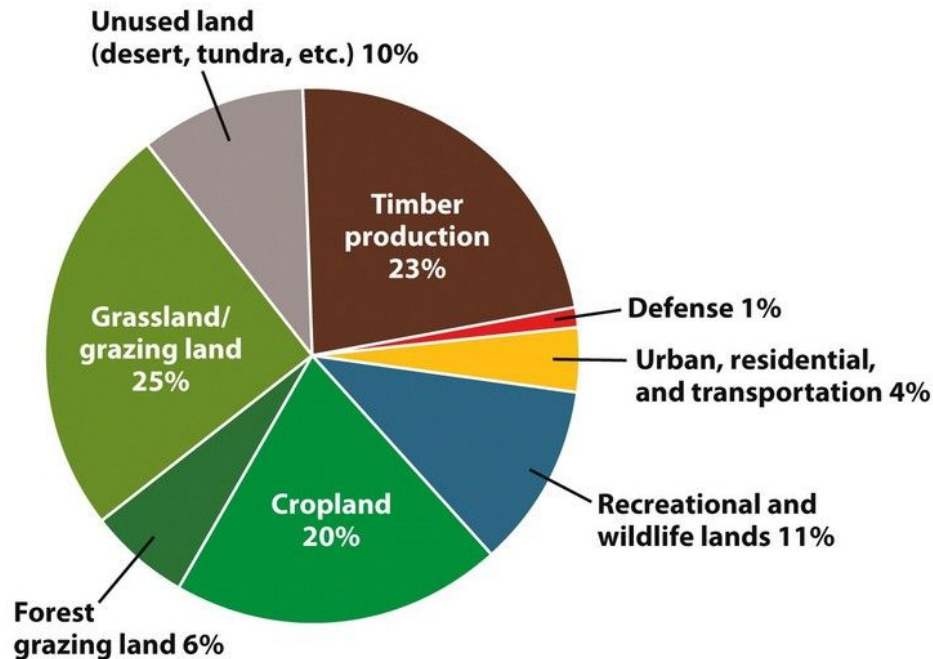


This leads to conflict with trying to use the land for different reasons. **Multiple-use lands** is a U.S. classification used to designate lands that may be used for recreation, grazing, timber harvesting, and mineral extraction. Other areas are designated as protected lands in order to maintain a watershed, preserve wildlife and fish populations, or maintain sites of scenic, scientific, and historical value.

Public Lands in the United States

More than 95 percent of all federal lands are managed by four federal agencies and their *typical* divisions:

1. Bureau of Land Management (BLM)
 - a. Grazing, mining
 - b. Timber harvesting
 - c. Recreation
2. United States Forest Service (USFS)
 - a. Timber harvesting
 - b. Grazing
 - c. Recreation
3. National Park Service (NPS)
 - a. Recreation
 - b. Conservation
4. Fish and Wildlife Service (FWS)
 - a. Wildlife conservation
 - b. Hunting
 - c. Recreation



Module 30: Land Management Practices

After this module you will be able to.....

- 1) Explain specific land management practices for rangelands and forests
 - 2) Describe contemporary problems in residential land use and some potential solutions
-

Land Management Practices

Land management practices vary according to land use. This can get very complicated and is one of the most challenging environmental science issues. This module will focus on management practice in rangelands and forests, with a focus on timber management practices and fire management. There will also be some focus on trends in residential land and the causes and consequences of urban sprawl.



Rangelands

Rangelands are dry, open grasslands primarily used for grazing cattle and happen to be the most common use of land in the United States. Rangelands are semiarid leading them to be susceptible to fires and other environmental disturbances that can cause loss of biodiversity.



Rangelands



Benefits of grazing livestock

- Uses much less fossil fuel energy than raising them in feedlots
- Can help maintain grasslands
- Can prevent less desirable species from becoming dominant
- Introduces animal waste and aerates the soil, both of which are beneficial to ecosystems

Improper management can lead to....

- Damaging of stream banks and pollution of surface waters
 - Denude a region of vegetation
 - Exposure to wind erosion which makes it difficult for soils to absorb and retain water and nutrients when it rains
-

Rangelands

Many environmental scientists argue that rangelands are too fragile for multiple uses. The [Taylor Grazing Act of 1934](#) was passed to halt overgrazing. It converted federal rangelands from a commons into a permit-based grazing system, thus avoiding tragedy of the commons. However, critics maintain that the low cost of the permits continues to encourage overgrazing.

The BLM focuses on mitigating the damage caused by grazing and considers “rangeland health” when it sets grazing guidelines, however, BLM managers are not consistently successful in preserving vulnerable rangeland ecosystems since they lack detailed guidance and the involvement of environmental scientists.

Forests



Forests are land that is dominated by trees and other woody vegetation and sometimes used for commercial logging. Many national forests were originally established to ensure a steady and reliable source of timber and commercial logging companies are currently allowed to harvest U.S. national forests in exchange for a percentage of their revenues.

Forests - Timber Harvest Practices



↓
Regrowth



(a) Clear-cutting

The two most common ways to harvest trees are *clear-cutting* and *selective cutting*. **Clear cutting** involves removing all, or almost all, the trees within an area. This is usually the easiest and most economical way. Trees can be replanted at the same time resulting in all trees being the same age. This method also allows fast-growing tree species to achieve their maximum growth rates since they are exposed to full sunlight.

Forests - Timber Harvest Practices



↓
Regrowth



(a) Clear-cutting

Clear cutting does have some disadvantages.

- Increase wind and water erosion which causes the loss of soil and nutrients
 - Erosion can also add silt and sediment to nearby streams harming aquatic populations
 - Denuded slopes are also prone to mudslides
 - Increases amount of sunlight that can raise water temperatures
-

Forests - Timber Harvest Practices



↓
Regrowth



(b) Selective cutting

Selective cutting removes single trees or a relatively small number of trees from the larger forest. This provides optimum growth among shade-tolerant tree species. This also provides less extensive environmental impact compared to clear cutting.

Note that both cutting methods require roads to be constructed which fragment the area and affect species diversities.

Forests - Timber Harvest Practices



A third approach to logging is **ecologically sustainable forestry**, which is removing trees from the forest in ways that do not unduly affect the viability of other non commercial tree species. The goal of this approach is to maintain both plants and animals in as close to a natural state as possible. Some loggers have even returned to using animals such as horses to pull logs in an attempt to reduce soil compaction.

Forests - Logging, Deforestation, and Reforestation

Almost 30 percent of all commercial timber in the world is produced in the United States and Canada. Although deforestation and land loss and destruction is relatively small in these countries, it still presents ecological challenges.

Logging often replaces complex forest ecosystems with **tree plantations**, or large areas with a single rapidly growing tree species. The USFS have provided federal regulations to help maintain an appropriate habitat for plant and animal communities.



Forests - Fire Management

In many ecosystems, fire is a natural process that is important for nutrient cycling and regeneration. A large amount of dead biomass can build up in areas with no fires.

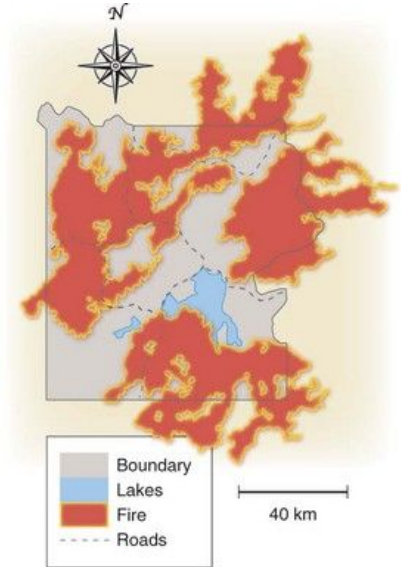
One way to combat this is using a **prescribed burn**, or a fire that is deliberately set under controlled conditions in order to reduce the accumulation of dead biomass on a forest floor. This also helps reduce uncontrolled fires and an increase in fire-dependent species.



Forests - Fire Management

One of the best-known forest fires in the United States are those that occurred in Yellowstone National Park in the summer of 1988, the driest year on record at the park where a combination of human activity and lightning set off multiple fires. Over 25,000 people fought the fires leaving only $\frac{2}{3}$ of the park unburned.

Although people were outraged that the NPS had “allowed” the park to burn, a few years later it became clear that the fires had created a new, nutrient-rich habitat for early-successional plant species that attracted elk and other herbivores.



National Parks



As already discussed, many national parks were established to preserve scenic views and unusual landforms. Today, they are managed for scientific, educational, aesthetic, and recreational use. After Yellowstone National Park was founded in 1872, 57 additional parks have been established in the United States. Today the NPS manages more than 400 national parks and other areas, such as historical parks and national monuments.

The United States'

National Parks'

2014 Recreational Visitors



National Parks - Goal



In 1963 and advisory board on wildlife management presented a report that established the guiding principles of national park management that are followed today. It proposed that the primary purpose of NPS should be to maintain the parks in the same biotic condition in which they were first found by European settlers.

National Parks - Human Activities



Although many parks are designed for human recreation, overuse has led to harming the environment. Some examples include ATVs and snowmobiles that cause noise pollution and soil disruption.

Park rangers struggle with how to determine appropriate limits on human activity and in many cases, there is no easy answer to the trade off between short-term recreational uses and long-term protection of biodiversity.

Wildlife Refuges and Wilderness Areas



National wildlife refuges are the only federal public lands managed for the primary purpose of protecting wildlife. **National wilderness areas** are set aside with the intent of preserving large tracts of intact ecosystems or landscapes.

These areas allow only limited human use and are designated as roadless. Logging, road building, and mining are banned in these areas. (Note that some roads and activities are grandfathered in some areas)

Federal Regulation of Land Use

The 1969 **National Environmental Policy Act (NEPA)** mandates an environmental assessment of all projects involving federal money or federal permits. However, before a project can begin NEPA rules require that the developers to file an **environmental impact statement (EIS)**, which is a document that outlines the scope and purpose of a development project, describing the environmental context, suggesting alternative approaches to the project, and analyzing the environmental impact of each alternative.

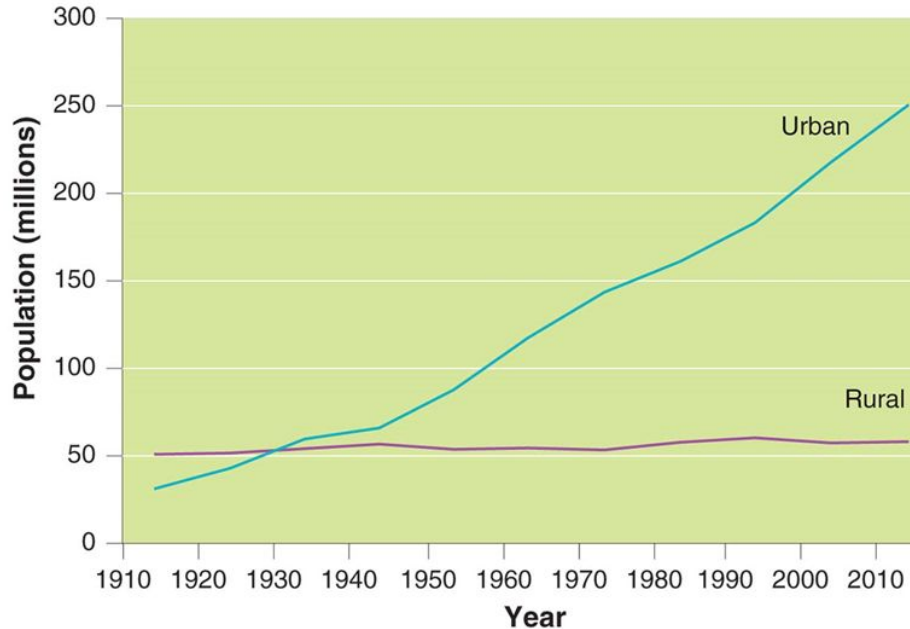


Federal Regulation of Land Use

Sometimes NEPA may have building permits or government funds withheld until the developer submits an **environmental mitigation plan**, which outlines how a developer will address concerns raised by a project's impact on the environment. The **Endangered Species Act** of 1973 is designed to protect species from extinction.

Members of the public are entitled to comment on the environmental assessment and decision makers are required to respond, however, developers are not obligated to act in accordance with public wishes.

Residential Land Use

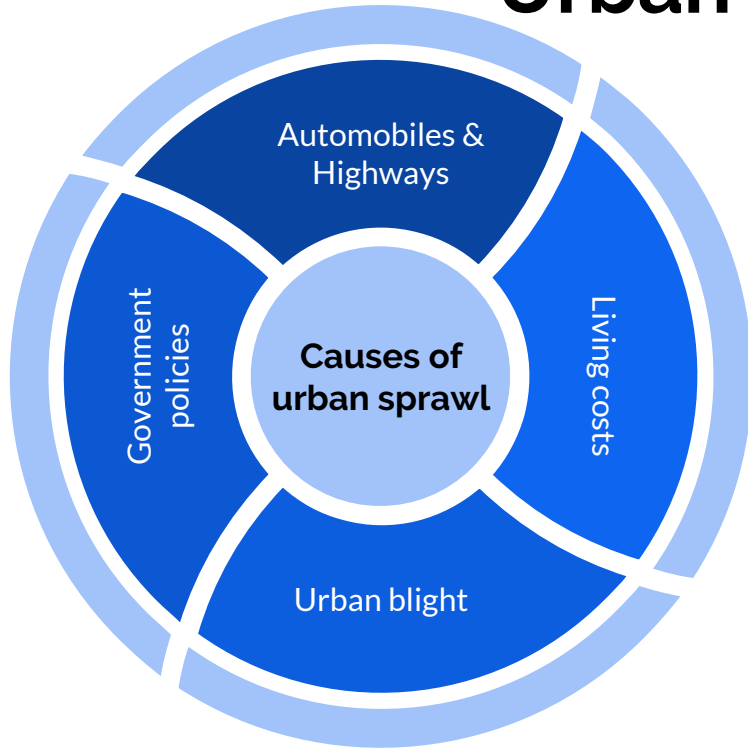


Suburbs are areas that surround metropolitan centers and have low population densities compared with urban areas.

Exurbs are similar to suburbs, but are not connected to any central city or densely populated area.

Figure 30.7
Environmental Science for AP®, Second Edition
Data from <http://www.census.gov/geo/reference/ua/urban-rural-2012.html>

Urban Sprawl



Urban sprawl are urbanized areas that spread into rural areas, removing clear boundaries between the two. This is usually caused by a cluster of housing, retail shops, and office parks, and ultimately has a dramatic environmental impact.

Suburban residents must drive more than twice as much as people who live in cities, communities use more than twice as much land per person than urban communities, and farmland is being converted for residential use.

214 S
8th - 3rd St
Houston - Tuleton
University
1/2 mi

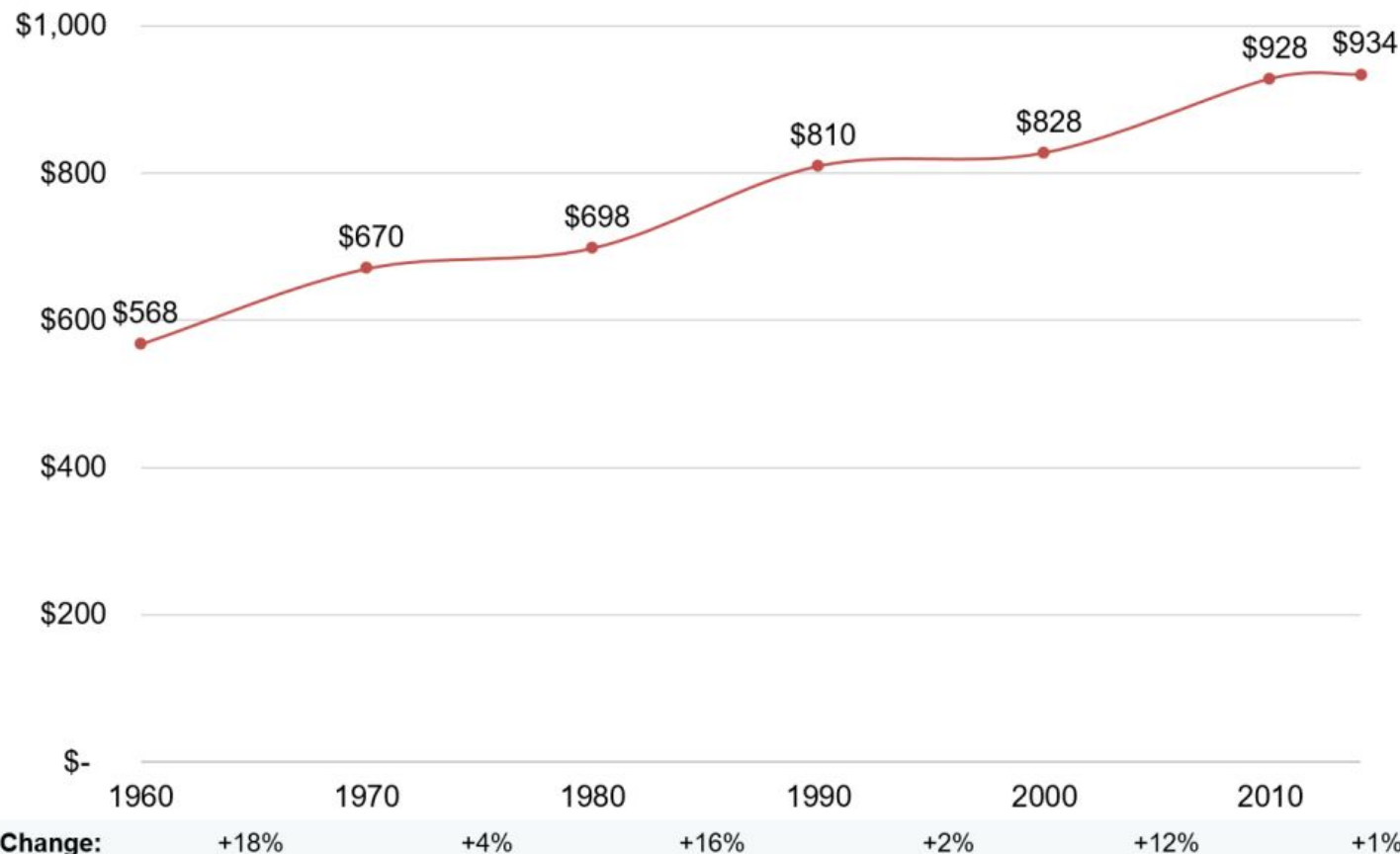
214 S
12th - 8th St
State Capitol
1/2 mi

EXIT 234B

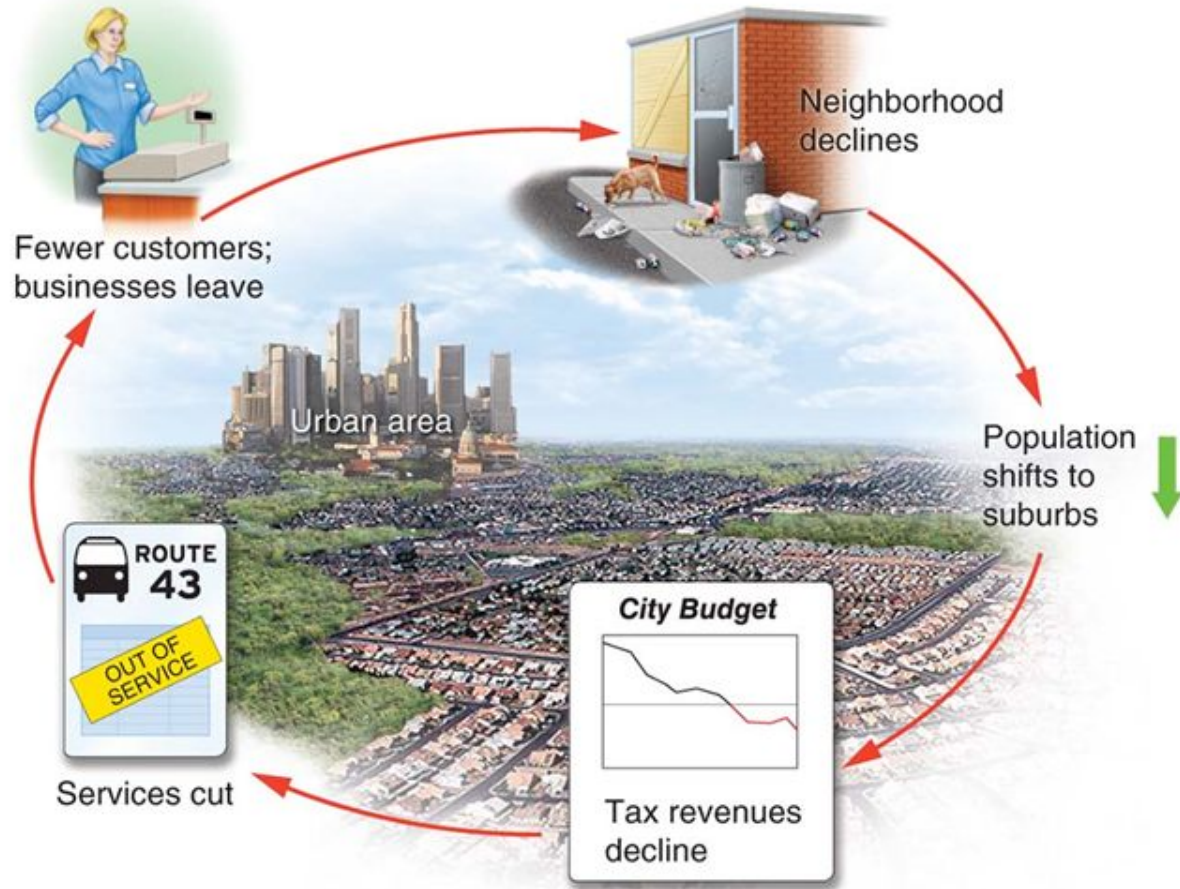
Austin
Convention
Center
SECOND RIGHT



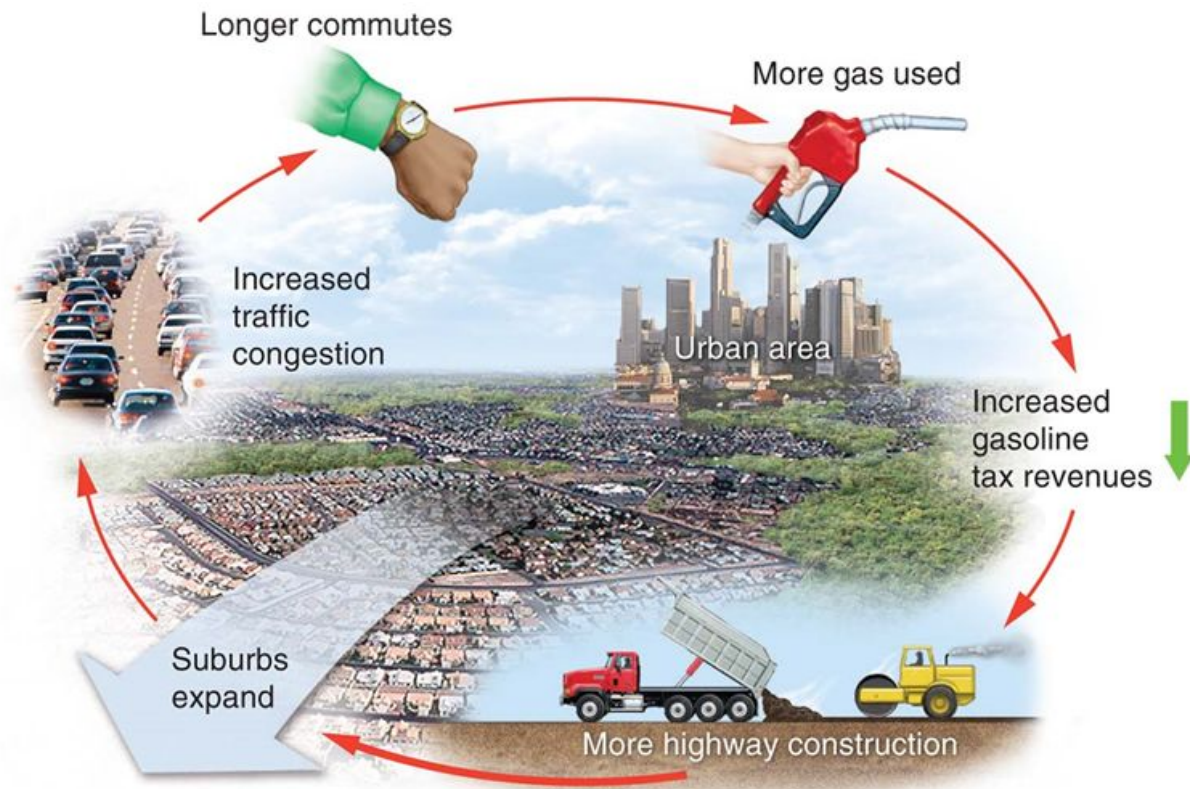
United States median rents (adjusted to 2014 dollars)



Note: Chart only includes data for 1960, 1970, 1980, 1990, 2000, 2010, and 2014
Source: 1960-2000 Decennial Censuses and 2010-14 American Community Surveys



Urban blight is the degradation of the built and social environments of the city that often accompanies and accelerates migration to the suburbs.



The **Highway Trust Fund** is a U.S. federal fund that pays for the construction and maintenance of roads and highways. This can lead to **induced demand**, which is an increase in the supply of a good causes demand to grow.

Governments may use **zoning**, a planning tool used to separate industry and business from residential neighborhoods. This has led to **multi-use zoning**, which allows retail and high-density residential development to coexist in the same area.

Figure 30.9
Environmental Science for AP[®], Second Edition
© 2015 W.H. Freeman and Company

Smart Growth

1	Create mixed land uses
2	Create a range of housing opportunities and choices
3	Create walkable neighborhoods
4	Encourage community and stakeholder collaboration in development decisions
5	Take advantage of compact building design
6	Foster distinctive, attractive communities with a strong sense of place
7	Preserve open space, farmland, natural beauty, and critical environmental areas
8	Provide a variety of transportation choices
9	Strengthen and direct development towards existing communities
10	Make development decisions predictable, fair, and cost effective

Smart growth focuses on strategies that encourage the development of sustainable, healthy communities. The EPA lists 10 basic principles of smart growth.