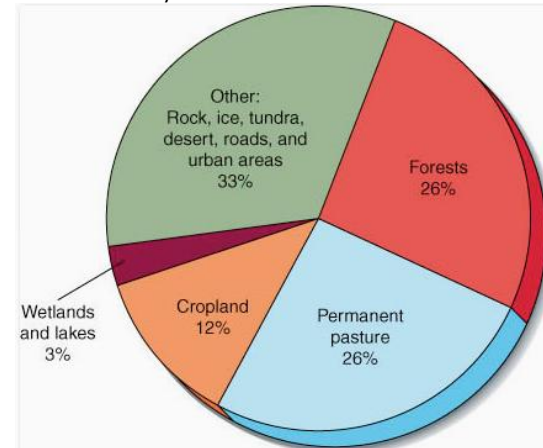




IV. Land and Water

Introduction to Land Resources

- ⌘ Importance of Natural Areas (rural lands = forests, grasslands, deserts, & wetlands)
- ⌘ provide ecosystem services that allow humans to live in unsustainable urban areas (ex. flood & erosion control, ground water recharge, breaks down pollutants, wildlife habitat)
- ⌘ used as comparison to urban areas to see extent of human damage
- ⌘ recreational value (fishing, hunting, boating, etc.)



B. Forestry

1. Tree plantations: (aka Tree Farms)

- a. Large tracts of land where trees are grown for the purpose of harvesting later for profit.
- b. Trees are all about the same age.
- c. Monocultures – only one type of tree is grown.
 - i. Pro: Easy to harvest
 - ii. Con: susceptible to disease / pests.
- d. Examples: orchards, pine forests
- e. Silviculture – the management of forest plantations for the purpose of harvesting for a profit.

2. old growth forests;

- a. virgin forests – have not been cut down & replanted; have not been seriously disturbed in hundreds of years.
- b. The US has the same amount of forest now as 100 years ago, however, only 5% are original forest.
- c. Large amounts of biodiversity
- d. largest in the US is in the Pacific Northwest
 - i. logging companies wanted to cut down part of the forest in the 1980s but were halted because of Northern Spotted Owls.
- e. Controversy – protected by federal laws, preventing loggers from coming in.
- f. Forests provide ecosystem services
 - i. Remove C from the atmosphere
 - ii. Provide O₂
 - iii. Provide food products for human consumption
 - iv. Animal habitat
 - v. Wood
 - vi. Fuel (from wood)
 - vii. Recreation
 - viii. Remove pollution; increase quality of soil & water

3. forest fires;

- a. Necessary for the survival of the forest.
- b. Fires help some trees (like pines) to reseed.
- c. Destroys the underbrush that competes with larger trees for nutrients.
- d. Large, healthy trees are not very affected by small fires
- e. Destroys leaf litter = which is a fuel for a bigger / unplanned fire
- f. Too many large trees = competition for resources.
- g. Controlled burns: performed by the National Forest Services – create fire lines and burn the area in between
 - i. Must have certain conditions:
 1. Done every 5 or so years, depending on growth of underbrush
 - a. Too much underbrush = too much “fuel” & fire can get out of control
 2. Can't be done when the area is particularly dry
 - a. Dry biomass = faster burn; hard to control
 3. Can't be done during windy times
 - a. if it's windy fire can jump across the fire lines.



- h. Natural burns: burns occur naturally because of lightning strikes
 - i. Controlled burns are done so the fire will not be out of control if there is a natural fire
- i. Unplanned burns – what Smokey the Bear warned us about!
 - i. Under the wrong conditions the fire gets out of control
 - ii. May not be prepared to protect nearby infrastructure
 - iii. Out of control burns put fire fighters, residents, and animals in danger
- j. TYPES of forest fires:
 - i. crown fires (occur in forests that haven't had recent fires – lots of energy)
 - ii. Ground Fires: occur underground & burn partially decayed leaves – common in bogs.
 - iii. Surface fires: burns undergrowth & leaf litter. Kills seedlings & smaller trees. Controlled burns help prevent crown burns.
- k. Controlling fires: Prevention = burning permits, closing forests when fire danger is high; Prescribed burns = purposely setting controlled fires.
- l. Grasslands & Chaparrals are also maintained by fires

4. forest management;

- a. Agroforestry: trees & crops are planted in the same area.
 - i. Mutualistic relationship that helps to control pests.

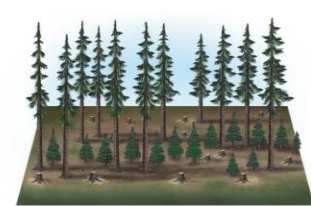
- b. Harvest Strategies:

- i. Clear-cutting: cutting down all trees in an area
 - 1. Pro: typically done in areas with fast growing trees; efficient
 - 2. Con: loss of biodiversity; disrupts ecosystem services (above)
- ii. Selective cutting: removal of select trees in an area.

(a) SELECTIVE CUTTING

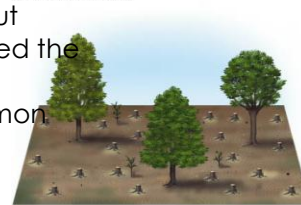


(b) SHELTERWOOD CUTTING



- 1. Shelter-wood cutting: mature trees are cut over time, but some are left behind to seed the area.
- 2. Uneven-aged management: more common in areas where trees that take longer to grow.

(c) SEED TREE CUTTING



(d) CLEAR-CUTTING



5. national forests

- a. National Forest Policy
- b. Federal government owns about 35% of land in US

C. Rangelands

1. Overgrazing;

- a. Agricultural Lands = thanks to corporate farming with hybrid crops, many old farms not needed so return to forest or grassland
- b. Too many grazing animals = compact soil; loss of ground cover; nutrient depletion of soil

2. deforestation;

- a. removal of trees for agricultural purposes (pastures & farms), home building (MDCs) or purposes of exportation (LDCs)
- b. MDCs have a larger demand for wood but less deforestation b/c of importation from LDCs
- c. Problem w/ reforestation: takes decades for trees to grow enough to be used; no substitute for large trees like the Giant Redwoods / Sequoias.
- d. Land is often cleared to make room for pastures, mining sites, petroleum sites, etc.
- e. Reduction of ecological services (i.e. O₂ production, habitat, nutrient cycles, food chains, etc)
- f. In tropical rainforests:
 - i. Typically done to create crop land, but the soil is nutrient poor so crops can't be supported for long.
 - ii. Abandoned cropland becomes pasture, which further depletes the soil.
 - iii. Loss of biodiversity
 - iv. Hard to selectively cut valuable trees (i.e. teak & mahogany); many other trees are harmed as a result.

3. desertification;

- a. Process by which a semi-arid region becomes a desert

- b. Overgrazing leads to compact soil = water cannot penetrate the ground = less evaporation = less rainfall.
- c. Overgrazing = less ground cover = fewer nutrients in the soil & increased erosion



4. rangeland management;

- a. Most in the US is located in the West.
- b. Provide pastureland, habitat for animals, plants; source of high-quality water, air, open space; recreational areas for hiking, camping, etc.
- c. Control # & distribution of livestock
- d. Restore degraded land
- e. Move livestock around so the land can recover
- f. Fence off riparian zones (areas around streams) to reduce damage
- g. Control invasive plant species
- h. Replant barren land with native grasses to reduce erosion
- i. Provide more food for grazing animals instead of just native plants
- j. Place water holes, water tanks & salt blocks in places that will encourage animals to avoid certain areas.

5. federal rangeland

- a. Jurisdiction is coordinated through Forest Service & Bureau of Land Management (BLM)
- b. Taylor Grazing Act (1934): requires grazing permits on federal land

D. Other Land Use

1. Urban land development

- a. **Planned development;** Urban Lands (humans use land for cities)
 - i. zoning regulations – control how land is used (some areas of city are only for houses, some only for business, etc.)
 - ii. Environmental impact Statements – Research must be done to a plot of land before building infrastructure.
 - 1. Performed by local agencies
 - 2. All must include
 - a. How the infrastructure will affect the environment (short term) – are any organisms affected, erosion, etc.
 - b. How the infrastructure may affect the environment in the future
 - c. What will be the cost of remediation if there is environmental damage
 - iii. cities (urban area = over 2500 people) growing rapidly since industrial revolution
 - iv. poverty increasingly prevalent in urban areas as poor migrate to cities looking for work = huge shantytowns around developing country cities (see Mexico City p.723)
 - v. Green Building:
 - 1. Energy conservation – government & private industry rebates as incentives for using solar energy, reducing energy through window placement, motion sensors, etc.
 - 2. Resource-effective building techniques & materials (renewable resources)
 - 3. Indoor air quality filters (may include greenhouses on roofs)
 - 4. Green roof systems: help keep the building cool
 - 5. Water conservation: xeroscaping; reusing gray water; low flush toilets
 - 6. Minimize waste in the construction process.
 - 7. Place buildings near public transportation (light rail, subways, etc)
 - 8. Pedestrian friendly areas; greenbelts; close shopping areas
 - 9. Preserve historical & cultural sites

b. suburban sprawl;



- i. People move away from the center of the city to neighborhoods further away.
- ii. Urban Growth in US
 - 1. 1800 = 5% urbanized (4 major shifts since then)
 - a. 1st shift: Migration to cities (75% urban today)
 - b. 2nd shift: Cities to Suburbs (41% in city/59% suburbs)
 - c. 3rd shift: Migration to South & West (since 1980 80% population growth in US has occurred here)

c. Urbanization

- i. Areas (ie cities) with a high population density
- ii. Many schools, infrastructure, hospitals, houses, shopping centers, etc.
- iii. Making Urban Areas Sustainable
 1. preserve open spaces for trees & common use parks
 2. have a "green belt" around downtown, then allow suburban development outside belt (link suburbs with mass transit). No building can be done in them; increases the quality of life of the residents.
 3. have "cluster housing developments" = pack houses tightly & leave 30% open for parks, etc.
 4. create rail systems / bus systems that encourage carpooling.

2. Transportation infrastructure

a. Federal highway system;

- i. Interstate highways paid by federal funding & comply with federal standards.
 1. Pro: less pollution b/c of reduced stop-and-go driving; reduces greenhouse gases; increases fuel economy (& reduces dependence on foreign oil), improves economy; improves quality of life (less time on the road)
 2. Cons: encourages urban sprawl
- ii. Taxes on gasoline help pay for roads (higher gas prices = better roads)

b. canals and channels

- i. body of water that connects two larger bodies of water
 1. Pros: less time / fuel to transport goods
 2. Cons: have to be dredged regularly to avoid siltation.
- ii. may be natural or manmade
- iii. Largest canals in the world
 1. Panama Canal (48 miles) – connects Pacific to Atlantic oceans.
 2. Suez Canal (163 miles) – connects the Red Sea with the Mediterranean sea
- iv. Maintained by the US Dept of Interior

c. roadless areas;

- i. logging & other development cannot occur.
- ii. Provides habitat for organisms.
- iii. Includes National wilderness areas
- iv. Roadless Area Conservation Rule: places about 1/3 of national forest system's total acreage off limits to roads; allows for recreation.

d. ecosystem impacts

How transportation affects urban development

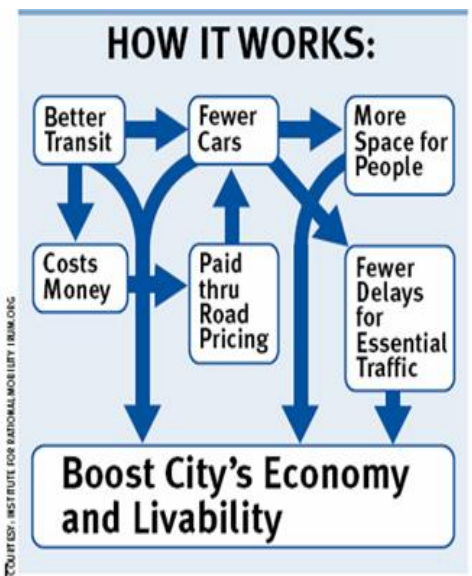
- ⌘ because so little land is available in Japan & Europe: more vertical growth of cities (in NYC people are required to purchase "air space" when building up.)
- ⌘ In US, Australia, Canada: Urban Sprawl or outward growth because there is more land
- ⌘ cheap gas + vast highways + sprawl = Automobile use dependent
- ⌘ sprawl makes infrastructure more expensive (got to stretch to suburbs)

Current Transportation Problems & Solutions

- ⌘ Individual Transport (cars & trucks)
- ⌘ in US, twice as many commuters from suburb to suburb than suburb to downtown = makes mass transit difficult (better emissions laws offset by more cars)
- ⌘ in US, more land dedicated to roads than houses
- ⌘ autos produce at least 50% of air pollution in US

Solutions to Auto Problems

- ⌘ Motor Scooters: heavy use in developing countries (can't afford cars) = more polluting than autos
 - Solution: replace gas burners with electric scooters



- ⌘ Bicycles & Walking: no pollution, heavy use in China (50%), Japan (15%), Western Europe (Denmark 30%), but US only 1% (too much sprawl)

Mass Transit

(3% of population use this in US, 15% Germany, 47% Japan)

Rail Systems

- ⌘ rapid rail (subway) - more efficient, less pollution must live near tracks, expensive
- ⌘ light rail (trolley) – cheaper for tracks than roads; need huge ridership to make \$ (i.e. need 150,000 cars off the road in Charlotte to pay for the light rail that we have now).
- ⌘ taxes must pay for new systems
- ⌘ Buses – lower cost than rail, more flexible, problem when caught in traffic, no profit if not full

Ways to control Auto use

- ⌘ User fees, higher parking fees, toll roads to pay for hidden environmental costs

3. Public and federal lands

a. Management; Land use in the United States

- Most federally reserved land in the US is in Alaska & the western states
- 55% privately owned / 42% public land (35% federal, 7% state & local)
- **4 agencies** operate federal land



Dept. of Interior

1. Bureau of Land Management (BLM) = mostly rangelands out west
2. Fish & Wildlife Service = manage National Wildlife Refuge (NWR)
3. National Park Service = manage National Parks
4. US Forest Service = manage National Forests

Dept. of Agriculture

b. wilderness areas:

- Wilderness Preservation Areas are open only for recreational activities w/ no logging permitted.
- Wilderness Act (1964): Established a review of road-free areas of 5000 acres or more & islands within National Wildlife Refuges or National Parks for inclusion in the National Preservation System. Restricted activities in these areas.
- Wild & Scenic Rivers Act (1968): Established a National Wild & Scenic Rivers system for the protection of rivers with important scenic, recreational, fish & wildlife & other values.

c. national parks:

- Yellowstone National Park: 1st NP in the world.
- National Park System (federal control) established in 1916 to manage & preserve forests & grasslands.
- Most visited National Park annually: Great Smokey Mountains (Blue Ridge Parkway)
- Threats: too many visitors; graffiti, air pollution b/c of vehicles, visitors collecting minerals/fossils/plants, fewer animals, proliferating wildlife populations

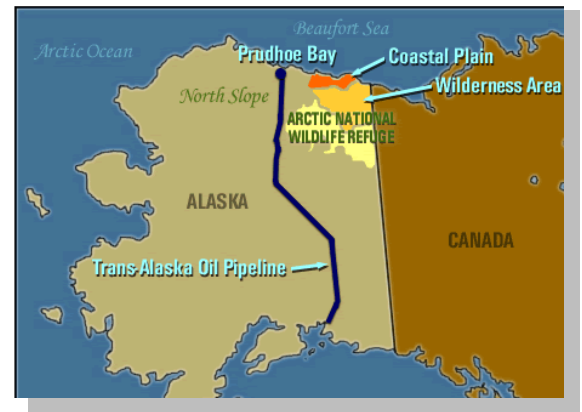
d. wildlife refuges:

- National Wildlife Refuges (federally controlled)
- Preserves land and waters for the conservation of wildlife
- Allows logging with a permit
- Alaskan National Wildlife Refuge is the largest in the world

1. Controversy surrounding drilling for oil

- Pro: US Geological Survey estimates there are up to 10 billion barrels of oil present; reduces reliance on foreign oil

- Con: arctic tundra is a fragile environment (slow to recover from damage b/c of the cold temperatures & few decomposing bacteria, simple food webs, low biodiversity which results in slow recovery rates, high sensitivity to environmental change, slow growth)



2. Construction of drilling sites, roadways, airstrips, housing facilities, pipelines, storage facilities, gravel mines as well as increased air travel, waste disposal sites needed, and increased likelihood of seismic activity.
 - a. Environmental impacts: loss of breeding grounds, food resources, shelters ; disruption of migration routes, hibernation areas; displaced populations; decreased water resources

e. forests;

- i. National Forest System (federal control)
- ii. Allows logging w/ a permit

f. Wetlands

- i. Areas that are partially wet part or all of the time.
- ii. Include swamps, edges of the ocean/ rivers, bogs, fens, etc.
- iii. Riparian Zones – areas directly around a river that are subject to flooding
- iv. Rich in biodiversity – many organisms digest toxins, releasing it back into the environment as a clean substance
- v. Threats: runoff from farms (animal & plant), mining (extraction of gravel, mining for fossil fuels & other minerals) , erosion (due to deforestation, logging, farms), dredging (to deepen navigation areas)
- vi. May be added to regions as a way of absorbing toxins from runoff – but take 50-100 years to be viable.
- vii.

4. Land conservation options

a. Preservation;

- i. encourage all users of public lands to feel responsible for land destruction
- ii. Land & Water Conservation Fund Act of 1968: Established a fund to assist states & federal agencies in meeting present & future outdoor recreation demands & needs
- iii. protect biodiversity & ecosystem services by requiring people to clean areas that have been compromised.
- iv. Do not allow tax deductions to companies that disrupt the land
- v. Require users to pay for extracting resources
- vi. Adopt uneven-aged management forestry practices

b. remediation;

- i. Correcting a fault or deficiency
- ii. phytoremediation (using plants to absorb toxins) or bioremediation (using microorganisms & bacteria to absorb toxins). Both are much cheaper than other methods of waste removal, however they take longer.

c. mitigation;

- i. to moderate or alleviate in force or intensity
- ii. Require those responsible for damage to pay for damages

d. Restoration

- i. Restore to its former condition.
- ii. Restore so that natural evolutionary environmental prevent further degradation

5. Sustainable land-use strategies

- a. Forests: cut down only what is needed.
- b. Allow controlled burns in grasslands, rangelands, and forests
- c. Use the land, but do so slowly so that it can “fix” itself

FIGURE: Major Uses of Land, 2002

<i>Land Use</i>	<i>48 States</i>	<i>All States</i>
Cropland	23%	20%
Grassland, pasture, and range	31%	26%
Forest-use land	30%	29%
Special uses	8%	13%
Miscellaneous land	5%	10%
Urban land	3%	3%

Source: Economic Research Service/USDA. *Major Uses of Land in the United States*. Economic Information Bulletin No. 14, 2006.